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ONR TROPICAL CYCLONE MOTION RESEARCH INITIATIVE: DATA USERS GUIDE TO OBSERVATIONS

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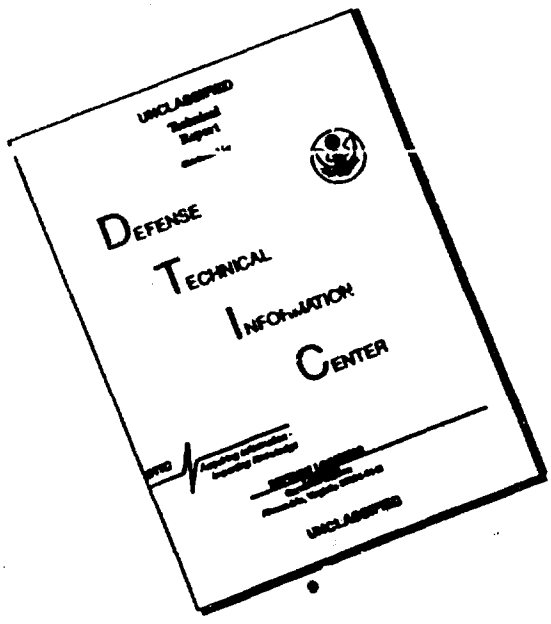

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Patrick A. Harr, Tamar Neta and Russell L. Elsberry

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THE VIEW EXPRESSED IN THIS REPORT ARE THOSE OF THE AUTHOR AND DO NOT REFLECT THE OFFICIAL POLICY OR POSITION OF THE DEPARTMENT OF DEFENSE OR THE U.S. GOVERNMENT

The Office of Naval Research Tropical Cyclone Motion initiative is a five-year program to improve basic understanding of tropical cyclone motion. The Tropical Cyclone Motion (TCM-90) field experiment was carried out during August and September 1990. The first section of this Guide describes the overall data collection that combines the real-time and delayed data. The second section describes the preparation of the eight observation types contained in the merged data set. The third section describes the data base and magnetic tape formats. The fourth section is a summary of the data aspects of each Intensive Observing Period.

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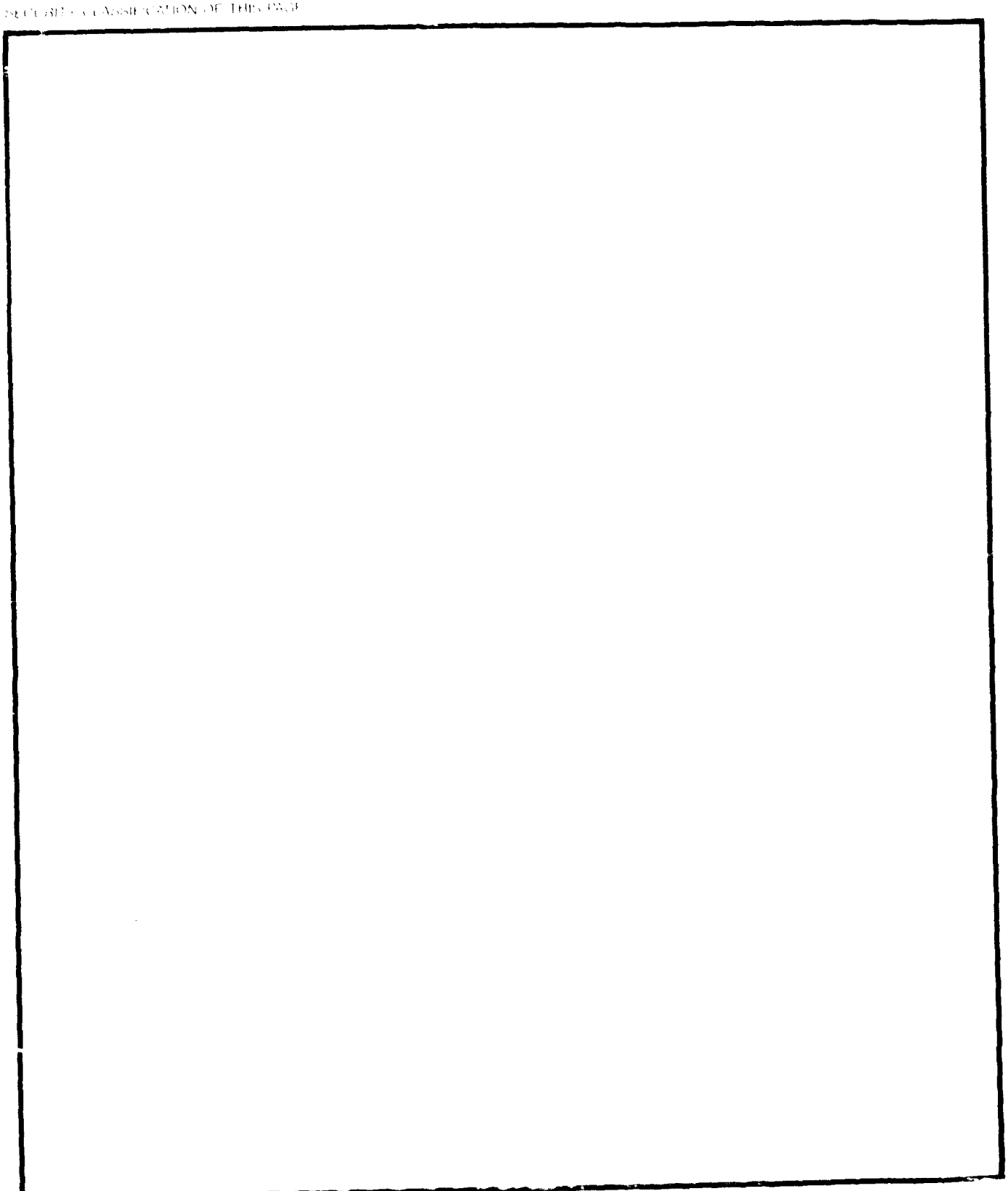

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INTRODUCTION

The Tropical Cyclone Motion (TCM-90) Data User's Guide addresses the collection, types, preparation, quality control, format and data base structure for all data collected during the field phase of TCM-90. Additionally, this Guide addresses the data collected from the three concurrent tropical cyclone field experiments (Elsberry 1990): (i) ESCAP/WMO Typhoon Committee Special Experiment Concerning Typhoon Recurvature and Unusual Movement (SPECTRUM); (ii) USSR TYPHOON-90 expedition; and (iii) Taiwan Area Typhoon Experiment (TATEX). The Data Management Plan contained in Elsberry et al. (1990) describes a framework for construction of a comprehensive data set that utilizes all of the data from the concurrent tropical cyclone experiments. This Data User's Guide will aid researchers who wish to utilize this complete data set.

As described in the TCM-90 Data Management Plan, the data management strategy is concerned with merging data collected in real-time (during the field experiment phase) with data collected in a delayed mode after the conclusion of the field experiments. The first section of this Guide describes the overall data collection that defines the combination of the real-time and delayed data. The second section contains descriptions of the preparation or pre-processing associated with the eight observation types contained in the merged data set. This includes discussions of quality control procedures that were applied to the real-time data. The third section describes the

data base and magnetic tape formats. Descriptions of the spatial and temporal characteristics of the data set are included. The fourth section contains a summary of the data aspects of each Intensive Observing Period (IOP). Appendix A contains the FGGE-IIB formats that are relevant to the TCM-90 data set. Appendix B contains the best-track data for the tropical cyclones that occurred during the field phase of TCM-90. Appendix C contains the job control language used to create the two TCM-90 data tapes.

1. DATA COLLECTION

The final TCM-90 data base is constructed from a combination of two data categories (Elsberry et al. 1990). Real-time data were collected during the field phases of the four concurrent tropical cyclone experiments. Delayed data were collected after the field phases. Certain observation types were only available as delayed data (e.g., flight-level data from the NASA DC-8 aircraft). The initial step in the collection process was to obtain the most complete set of real-time data available. Several procedures were then followed to detect when expected observations were not available in the real-time data set. It was necessary to determine if the data were missing because the observations were not taken, taken but not transmitted, or transmitted and not received. These decisions were made by comparing the real-time data set with data inventories supplied by data managers of the concurrent field experiments.

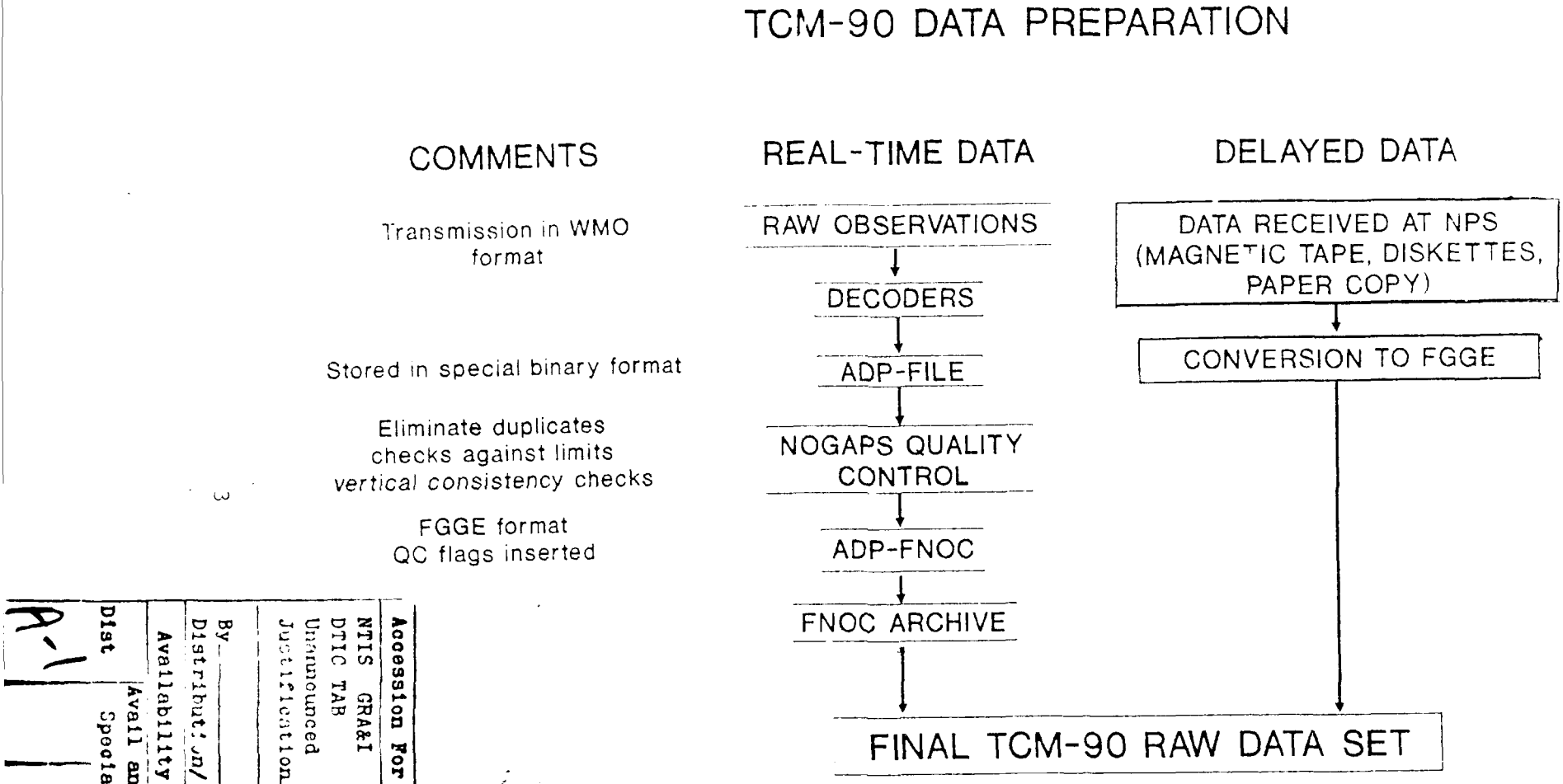


Figure 1.1 Real-time and delayed data preparation. The real-time data flow illustrates the processing performed at Fleet Numerical Oceanography Center.

1.1 REAL-TIME DATA

The real-time data were collected in conjunction with the global analysis and forecast cycle at Fleet Numerical Oceanography Center (FNOC), which is called the Navy Operational Global Atmospheric Prediction System (NOGAPS). Figure 1.1 illustrates the flow of data collected in real-time. The major processing steps include elimination of exact duplicates, conversion to FGGE-IIB format, and extensive quality control examinations that are an integral component of the NOGAPS. Each 12 h, all observation types received via the Automated Weather Network (AWN) at FNOC were stored on magnetic tape. These data provided an initial estimate of the amount of data that were being transmitted in real-time, and were used during the field phase to detect periods with low data counts. Immediately after the field phase was completed, the real-time final data set was obtained from the FNOC data archive. This data archive included observations received after the "cut-off time", when the initial set of real-time data were dumped to magnetic tape. This final step insured that all possible real-time data were collected.

The real-time component of the final data set contains FGGE-IIB formatted data that had passed through the NOGAPS quality control system. This system flags each observation according to the expected accuracy of the data for each observation type. Details are provided in Section 2.

1.2 DELAYED DATA

Delayed data originate from two possible circumstances. The first arises when conventional observation types were either not transmitted, or transmitted and not received. During the field phase of the Tropical Cyclone Motion experiment, it was not possible to arrange for each special observation type to be transmitted in real-time. For instance, only the radar wind profiler at Kadena Air Force Base, Okinawa was able to transmit data in real-time. Post-processing of these observations produced more accurate, consistent, and complete profiles for inclusion in the final data set. Extensive monitoring of the real-time data at FNOC also revealed several deficiencies in the original transmission plan that required replacement with delayed data.

The second type of delayed data involves either conventional or special observation types that were post-processed in some manner. Examples of post-processed data are: (i) reprocessed satellite cloud-tracked winds; (ii) checked flight-level data from the NASA DC-8 aircraft; (iii) processed dropwindsonde soundings; (iv) radar wind profiler observations; and (v) checked rawinsondes from ships and land stations.

As shown in Fig. 1.1, the delayed data were received at the Naval Postgraduate School on a variety of mediums. Those observations that were not available in real-time were converted to FGGE-IIB format. The quality control flags are set to indicate that these delayed data did not undergo the same type of

processing as the real-time data. Consequently, users will be able to separate observations that have or have not been quality controlled.

1.3 MERGER OF REAL-TIME AND DELAYED DATA

The final real-time data set was examined to determine when expected observations were not present. This process primarily concentrated on rawinsonde data. Lists of missing data were compiled and compared with data received from SPECTRUM and several individual nations/agencies. In some instances, lists were sent to agencies to confirm whether observations were not taken, taken and not transmitted, or transmitted and not received. When all possible data sources were exhausted, the delayed and real-time data sets were merged.

The existence of duplicate observations in the final merged data set is an important aspect of the data processing. As mentioned above, exact duplicates were eliminated as part of the regular processing of the real-time data set. If observations from the real-time data set were later duplicated in the delayed data set, both versions were placed in the final merged data set only if they were not exactly the same. The version that comes from the delayed data set is identified by the quality control flags, which are set to indicate that the data did not pass through the NOGAPS quality control system.

2. DATA PREPARATION

2.1 REAL-TIME DATA

The real-time data were processed by an automated quality control system at FNOC (Baker 1991). The system was developed to support the multivariate optimum interpolation (MVOI) analysis that is used by NOGAPS. Details of the quality control procedures are available in Baker (1991). Specific features that are relevant to TCM-90 are described in the following subsections.

Two quality control components that pertain to all observation types are the quality control flags, and treatment of duplicate reports. Quality flags are assigned according to the severity of any error detected through internal consistency checks or against climatological limits. The quality flags depend upon observation type, and are defined in Appendix A. Since the real-time data were captured following the quality control procedures, they had not passed through the MVOI component of NOGAPS. Therefore, the quality flags assigned to each observation do not pertain to horizontal "buddy" checks, or to checks against a background field, that are part of the MVOI.

Exact duplicate reports of all observation types are eliminated prior to the NOGAPS quality control examinations. However, the quality control system examines near-duplicate reports that may arise from corrections to reports transmitted earlier. The correct report is not always known because the time of receipt is not stored. Elaborate schemes have been designed

to choose among nearly duplicate surface and rawinsonde reports (Baker 1991).

2.1.1 RAWINSONDE OBSERVATIONS

The TCM-90 rawinsonde data set includes land and ship observations. Most observations contain both mandatory and significant level data. However, National Weather Service stations (i.e., U. S. Pacific Island stations) report significant level winds in pilot balloon (PIBAL) format.

The most extensive quality control examinations are applied to rawinsondes because they are a heavily weighted data source in the MVOI. Details of the procedures are provided in Baker (1991). More attention is given to examination of mandatory level data because they are used by the MVOI.

Rawinsonde data undergo detailed vertical consistency checks. These include gross error checks, lapse rate checks, and vertical shear checks on wind direction and speed. One important aspect of the rawinsonde quality control procedures is that suspect mandatory level heights and temperatures are recomputed, if possible. Mandatory level temperatures that were flagged "suspect" during the lapse rate check are recomputed from adjacent significant level data. All reported heights are checked against hydrostatically computed heights using the checked temperature data.

When original reported values are replaced with computed data, they are appropriately flagged (Appendix A). Furthermore, a "dummy" observation record is created to contain

the original suspect data. This new observation uses the same dictionary line as the original one. Therefore, it will appear as a duplicate report from the same station, but it will typically contain very few levels. The data will also be flagged as being "suspect" or "bad".

Rawinsonde observations from Taiwan that were received in real time may be repeated with Chinese block numbers. Generally, the observations are not identical. There is no basis for deciding which report is more accurate. Both are processed through the quality control procedures, and both are retained in the TCM-90 data base.

2.1.2 PILOT BALLOONS (PIBALS)

PIBAL reports contain observations of wind direction and speed as a function of height or pressure. PIBALS are checked against climatological limits, and checked for internal consistency. The internal consistency checks are identical to the examination of the vertical shear of wind direction and speed that are applied to rawinsonde data. No corrections are applied to erroneous data.

2.1.3 SURFACE DATA

The real-time surface observation types contained in the TCM-90 data base include synoptic reports from land stations, coastal marine stations, mobile and fixed ship stations, and drifting and fixed buoys. Although most of the reports from the drifting buoys deployed for TCM-90 were received in real time, they are stored separately from other real-time buoy data (see

Section 2.2.4).

Surface observations are checked against climatological limits. Unlike rawinsonde observations, no corrections are applied for suspect data. However, ship positions are examined for continuity, and may be changed if a position is outside a region defined by extrapolation from previous positions.

2.1.4 AIRCRAFT OBSERVATIONS

Real-time aircraft reports mainly consist of conventional aircraft reports (AIREPS). Only rarely are reconnaissance data received in real time. These are assigned the identifier, RECCO. AIREP reports typically consist of wind direction and speed at a specific altitude. AIREPS are reported at predefined latitude and longitude positions. Therefore, observations tend to be centered at the same position, but with slightly different altitudes and/or times.

AIREP data are subjected to checks against climatological limits, and checks for consistency within the wind report. No corrections are made for erroneous data.

2.1.5 SATELLITE SOUNDINGS

The real-time satellite sounding data consist of Tiros operational vertical sounder (TOVS) soundings from the NOAA polar orbiting satellites, and special sensor microwave temperature (SSM/T) soundings from the Defense Meteorological Satellite Program (DMSP) satellites. FNOC receives these profiles from Carswell Air Force Base. Satellite sounding data are archived in terms of layer thicknesses up to 1 mb, and precipitable water up

to 300 mb (NOAA only). The horizontal resolution of the data is approximately 150 km.

The satellite data are checked against climatological limits, and for internal consistency. Unlike other upper-air data, quality flags are not applied to individual levels. Instead, the entire sounding is assigned a general quality flag. Errors detected in the precipitable water data result in a label of "suspect". Errors in the thickness data result in a "bad" label. No corrections are made for erroneous data.

2.1.6 SATELLITE CLOUD-TRACKED WINDS

The TCM-90 data base contains real-time satellite cloud-tracked winds from the Japanese Meteorological Agency. Occasionally, data from India are included.

Satellite cloud-tracked winds are checked against climatological limits, and for internal consistency. Although it is known that the height assignments of these winds are often suspect, no corrections have been applied.

2.2 DELAYED DATA

Delayed data include observations that were either not received in real time or were reprocessed in some manner. These data did not pass through the quality control procedures used for the real-time observations. Some of the delayed data may have been subjected to a type of quality control before they were sent to the TCM-90 Data Center. This is certainly true for the reprocessed observations (i.e., satellite cloud-tracked winds,

dropwindsondes, radar wind profiler data). Quality flags associated with all delayed data were assigned, 0, which indicates that "vertical quality checks were not done". This is to distinguish them from the real-time data that passed through the FNOC quality control system.

2.2.1 RAWINSONDE OBSERVATIONS

Approximately 10-15% of the rawinsonde observations in the TCM-90 data base were delayed data from sources listed in Table 2.1. It was not possible to determine to what degree these data were checked at the source, but it was obvious that some of the data were not checked.

Table 2.1 Sources of delayed rawinsonde data.

LOCATION	SOURCE
Philippines	SPECTRUM
Taiwan	TATEX
Malaysia	Malaysian Met. Service
Clark AFB/ Cubi Pt.	TCM-90 Observers
Iwo Jima	NOCF Yokuska
Pacific Islands, NWS stations	NWS
Saipan	TCM-90 Observers
Japanese Ships	SPECTRUM
USSR Ships	TYPHOON-90

2.2.2 PILOT BALLOONS - RADAR WIND PROFILERS

No standard PIBAL observations were received as delayed data. Significant level wind data from delayed National Weather

Service observations were stored with the mandatory level data as part of rawinsonde report during the conversion to FGGE-IIB format.

All radar wind profiler data from the tropical cyclone experiments are stored in a PIBAL format because only winds at fixed elevations are included. The profilers were located on Taiwan, Okinawa, Japan, Ponape and Saipan. The typical vertical resolution of the wind data is 300-500 meters. The temporal resolution of the data stored in the data base is 1 hour. Finer resolution in time (6 minutes) may be available on request.

The NPS 404.37 Mhz profiler operated in a low mode (250 km resolution) and a high mode (1 km resolution). The low mode was used to obtain data from near the surface to 8-10 km, and winds at higher altitudes were obtained via the high mode.

All of the radar wind profiler data were post-processed to some degree. The data from the NPS profiler at Kadena AFB was quality checked to extract the best set of valid winds. Post-processing concentrated on removing the influence of scattered precipitation that fell unevenly across the three radar pulse beams. An extension of the standard NOAA consensus routine was applied to reduce the fraction of winds contaminated by precipitation (Dobos et al., 1991).

2.2.3 SURFACE SYNOPTIC DATA

Delayed hourly surface synoptic reports on the USSR ships were received from TYPHOON-90 and from SPECTRUM for WMO block 47 stations (i.e., Japanese islands).

2.2.4 TCM-90 DRIFTING BUOY DATA

Surface reports from the network of 11 drifting buoys were available at the Joint Typhoon Warning Center during the field phase of TCM-90. These data were used to supplement the real-time observations received at FNOC. Occasionally, the original buoy identifier was lost or garbled on transmission. When this occurs, the generic identifier DRIBU is assigned to the report.

The original drifting buoy numeric identifiers are converted to alphanumeric names when the data are stored in FGGE-IIB format at FNOC. Table 2.2 provides the conversion between the original buoy numbers and the names contained in the data base. Furthermore, recommended sea-level pressure bias corrections derived by the European Centre for Medium Range Weather Forecasts (ECMWF) are also provided in Table 2.2. These recommended corrections, which are derived by comparison of the reported pressure with the ECMWF analyses, have not been applied in the data base.

Several Tropical Ocean Global Atmosphere (TOGA) moored buoys were received in real-time at FNOC. These reports were added to the TCM-90 buoy data set, rather than to the standard real-time surface reports portion of the TCM-90 data base (Fig. 2.1).

2.2.5 AIRCRAFT OBSERVATIONS

The flight-level data from seven NASA DC-8 missions were incorporated as delayed AIREP reports (Figs. 2.2-2.8) The

data were quality checked by NASA. These reports contain flight-level wind, height, pressure, temperature and dew point depression. Individual reports are assigned identifiers of RECCO. Although the data were originally supplied with 1-second time resolution, only 5-minute data are stored on the data base. These 5-minute resolution data are obtained by averaging over 2-minute intervals centered on the 5-minute boundary. Higher resolution data are available on request.

2.2.6 SATELLITE SOUNDINGS

The satellite data center (University of Wisconsin) archived all satellite sounding data that were available in real time. These data essentially duplicate those obtained from FNOC, except the soundings are stored as layer mean temperatures rather than thickness, and the horizontal resolution is 75 km instead of 150 km. The sounding observations from the satellite data center were not converted to FGGE-IIB format, and are not contained in the TCM-90 data set. They are available in the University of Wisconsin archive format upon request.

Table 2.2 TCM-90 buoy numbers, names and bias corrections recommended by ECMWF.

Buoy number	Buoy name	Sea-level pressure bias
290	EBEBC	-2.5 mb
729	EBEBE	indeterminable due to extreme variations
731	EBEBG	indeterminable due to extreme variations
730	EBEBF	-7.2 mb

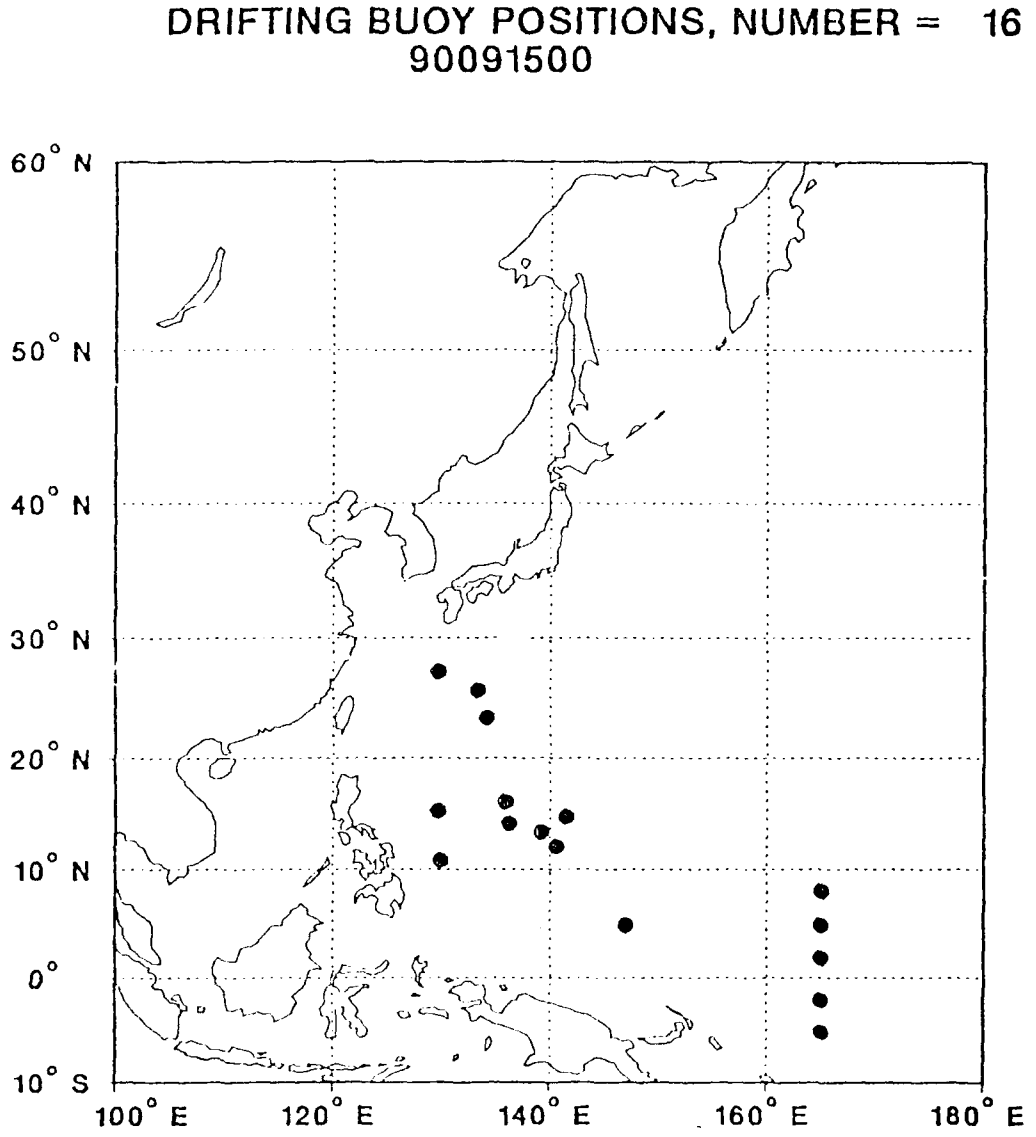


Figure 2.1 Positions of TCM-90 and TOGA buoys on 00 UTC 15 September 1990. The TOGA buoys are aligned along 165°E.

Table 2.2 TCM-90 buoy numbers, names and bias corrections recommended by ECMWF.

Buoy number	Buoy name	Sea-level pressure bias
290	EBEBC	-2.5 mb
729	EBEBE	indeterminable due to extreme variations
731	EBEBG	indeterminable due to extreme variations
730	EBEBF	-7.2 mb
732	EBECJ	0.0 mb
736	EBEBA	-5.5 mb
737	EBEBB	-4.7 mb
760	EBEJA	-2.3 mb
761	EBEJB	3.1 mb
762	EBEJC	2.1 mb
763	EBEJD	0.0 mb

2.2.7 SATELLITE CLOUD-DRIFT WINDS

The Satellite Data Center, under the direction of Chris Velden, provided a set of reprocessed satellite cloud-drift wind observations. These high quality data were manually processed through careful analysis of the GMS imagery. The reprocessed data sets were produced at 6-h intervals only during TCM-90 Intensive Observing Periods (IOPs). The data are vertically distributed between 850 - 150 mb (Table 2.3). The data coverage is between 110°E-160°E and the equator and 50°N.

There is some overlap between the reprocessed cloud-drift winds and the operational cloud-drift winds obtained in real-time. Some validated operational wind data are contained in

the reprocessed data sets. The spatial coverage of the operational data is larger than the reprocessed data. Both data sets are retained in separate files in the TCM-90 data base.

Table 2.3 Vertical distribution of reprocessed satellite cloud-drift winds during these Intensive Observing Periods (IOP).

LEVEL mb)	90091312-90091412 IOP-5	90091418-90091612 IOP-6	90091618-90091900 IOP-7
1000	0	0	0
850	300	934	1243
700	32	24	126
500	32	205	473
400	7	112	102
300	150	621	545
250	274	335	1020
200	542	1417	1284
150	335	896	875
100	0	0	0

2.2.8 DROPWINDSONDES

Reprocessed checked data from the LORAN dropwindsonde system onboard the NASA DC-8 were supplied by the National Center for Atmospheric Research (NCAR). There are 84 soundings from five flights (Table 2.4). All but six of the soundings are from the three Supertyphoon Flo flights (Dunnavan et al., 1991). The data are inverted and stored in the FGGE-IIB dropwindsonde format with a vertical resolution of 10 mb. The station identifier is set to NASDC8 for all reports.

Extensive editing of the dropwindsonde data was necessary because of problems with several sensors on the sondes. Only minimal wind data were recovered on the first six drops because the LORAN navigator had not been programmed for the relocation of the Yap LORAN station to Guam. After this correction was made, LORAN coverage was still poorer than expected, which resulted in marginal wind data on several drops. In some cases, the pressure sensor was apparently affected by internal condensation, which resulted in pressure readings that were too high during the final 50-200 millibars. Examination of the drops with reliable pressure readings near the surface suggested that the recorded splashdown heights were too low. Therefore, there may have been a discrepancy between the DC-8 radar altimeter and the reference pressure recorded prior to launch. The sonde pressure sensor was not calibrated to function at pressures lower than 200 mb.

Condensation also affected the temperature sensor on several drops, which resulted in double values near the end of the flights. Flights that suffered from temperature and pressure sensor problems are labeled in Section 4.

Because of the shock to the humidity sensor during launch from the DC-8, no humidity data are used for the first 100 seconds after the launch. It is believed that humidity readings may be 20% low for values above 50% due to several problems with the sensor.

In addition to the reprocessing at NCAR, a gross-error check was made before the data were stored in the TCM-90 data base. Nevertheless, the dropwindsonde reports must be regarded as experimental data and subjected to close scrutiny by the user.

2.2.9 ANALYZED FIELDS PRODUCED BY THE AUSTRALIAN BUREAU OF METEOROLOGY RESEARCH CENTRE (BMRC)

During the field experiment phase of TCM-90, the real-time data available on the Global Telecommunication System (GTS) were used by BMRC to produce analyzed data fields (Davidson et al. 1991). Analyses were produced every six hours using all data received within 12 hours after the analysis time. The horizontal resolution of the analyses is 100 km. The lower-left corner of the domain is 15°S,100°E and there are 75 grid points in both the north-south and east-west directions. The analyses were performed the following pressure (mb) levels: 1000, 850, 700, 400, 300, 200, 150, 100, 70, 50, and 10.

Details pertaining to the analyses procedures are available in Davidson et al. (1991). Inquiries or requests for these data fields should be directed to the BMRC.

3. DATA BASE FORMAT

The final TCM-90 data base contains observations in the area between 60°E - 180°E and 10°S - 60°N (Fig. 3.1). The data base is organized by observation type, time and location. Each observation type is contained in a separate file (Table 3.1). Each file is sorted by time, beginning on 00 UTC 1 August 90 and

ending on 00 UTC 20 September 90. The temporal resolution of the data varies for each observation type (Table 3.1). Original observation times have not been altered to fall on any standard synoptic times. For example, a USSR ship rawinsonde report at 13 UTC has not been altered to 12 UTC.

Within each time, the reports are first sorted by increasing latitude. Southern Hemisphere latitudes are negative, and Northern Hemisphere latitudes are positive. Within each latitude, the reports are sorted by increasing longitude beginning at 60°E and proceeding through 180°E.

All data are stored in FGGE-IIB format. Individual observation type formats, definitions, and quality flag codes are contained in Appendix A.

The entire TCM-90 raw observation data base can be stored on two 2400 feet magnetic tapes at a density of 6250 bytes per inch. Specific tape characteristics are provided in Table 3.2.

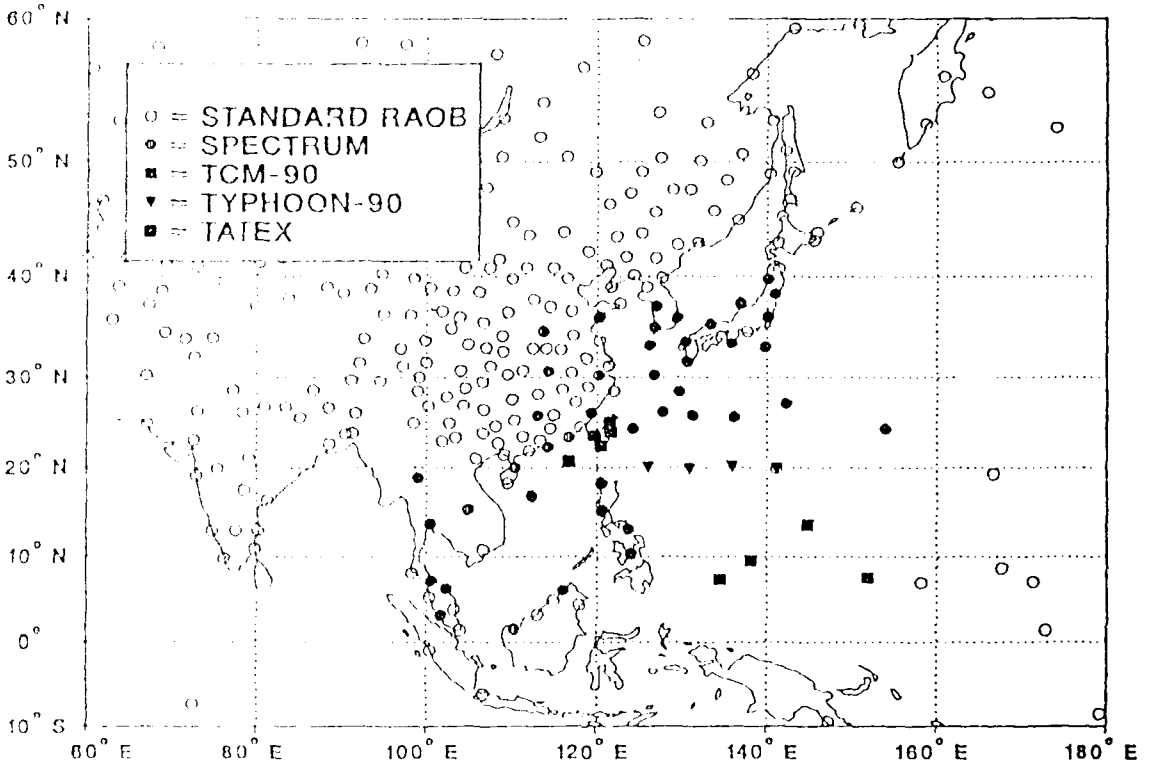


Figure 3.1 Rawinsonde coverage on 00 UTC 13 September 1990 as contained in the TCM-90 raw observation data set. Special soundings from the four coincident field experiments are indicated by filled symbols as indicated in the inset.

Table 3.1 Raw observation summary according to file name in the TCM-90 data base

OBSERVATION TYPE	FILE NAME	TIME RESOLUTION (non IOP)	TIME RESOLUTION (IOP)
Rawinsonde	T11	12 hourly	6 hourly
Pilot Balloons	T12	12 hourly	6 hourly
Aircraft - operational	T23	hourly	hourly
Aircraft (DC-8)	T23DC8	none	5 min. (1 sec. available)
Surface Reports (Land)	T31	3 hourly	3 hourly
Surface Reports (Fixed Ship/Buoys)	T33	3 hourly	3 hourly
Surface Reports (Mobile Ships/Buoys)	T34	3 hourly	3 hourly Some hourly
Satellite Soundings	T41	hourly	hourly
Satellite Cloud-tracked Winds (Ops)	T61	variable - generally 3 hourly	variable - generally 3 hourly
Satellite Cloud-tracked Winds (reprocessed)	T61WIS	none	6 hourly
TCM-90 Drifting Buoys	T81	variable - generally 4/day	variable - generally 4/day
Dropwindsondes	T15	none	variable

Table 3.2 TCM-90 raw observation data base magnetic tape characteristics.

Density	6250 bpi
Label	none
Block size	6400
Logical record size	40
Record format	Fixed block
Data type	ASCII

4. INTENSIVE OBSERVING PERIOD (IOP) SUMMARIES

Elsberry et al. (1990) provided synoptic and preliminary data summaries of each IOP (Table 4.1). This section contains updated information concerning the data aspects of each IOP. Some of the data system notes supplied in Elsberry et al. (1990) are repeated here for completeness.

Every IOP data summary includes tables and figures documenting data received from each rawinsonde station. Although a few stations made observations in 3-hour increments (i.e., Clark AFB, Philippines (98426) and Cubi Point, Philippines (98327)), the tables are in 6-hour increments. Observations taken one or two hours off time are labeled appropriately.

Satellite imagery data available through the Satellite Data Center (University of Wisconsin) are listed in a table for IOP.

Dropwindsonde data are listed by Table. The Tables also indicate if observations were contaminated by sensor problems discussed in Section 2.2.8.

Table 4.1 Times of TCM-90 Intensive Observing Periods

IOP	Beginning time	Ending time	Storm(s)
1	12 UTC 8 Aug	00 UTC 10 Aug	Winona
2	12 UTC 15 Aug	12 UTC 17 Aug	Yancy
3	00 UTC 18 Aug	00 UTC 20 Aug	Yancy/Zola
4	12 UTC 5 Sep	00 UTC 8 Sep	Dot
5	00 UTC 13 Sep	12 UTC 14 Sep	Ed
6	00 UTC 15 Sep	12 UTC 16 Sep	Ed/Flo
7	00 UTC 17 Sep	00 UTC 19 Sep	Flo

Updated Data System Notes:

1. The planned radar wind profiler installations on Iwo Jima and Minami Daito Jima were not possible due to logistic difficulties and lack of frequency approvals, respectively. A rawinsonde team was on Iwo Jima beginning on 15 August. Their observations were not available in real-time, but were added as part of the delayed data.

2. The installation of the Kadena AFB, Okinawa wind profiler was delayed so that observations were not obtained until 14 August.

3. No radar wind profiler was available for installation at Clark AFB, Philippines. A TCM-90 rawinsonde team was placed at Clark AFB and later switched to Cubi Point, Philippines on 15 August. These two stations alternated observations to provide 3-hourly observations during IOPs.

4. A rawinsonde team from Monash University provided observations from Saipan (Block station number 91232) throughout

TCM-90.

5. Radar wind profiler observations from Saipan, Ponape, Taiwan and the Meteorological Research Institute of Japan were only recently made available as delayed data. These reports have not been included yet in the data base and will be supplied later as a supplemental data set.

6. Although no real-time data were received from two Philippine stations (Laoag, 98223; Legaspi, 98444) during the first three IOPs, their observations were supplied as delayed data.

7. No rawinsonde launches at 18 UTC were made at Chi Chi Jima (47971) or Marcus Island (91131) during any of the IOPs.

8. Eleven of the original 12 drifting buoys successfully transmitted during TCM-90. Because of the variability in their transmission times, they are not summarized here. Generally, observations from the buoys are available four times a day.

9. Satellite cloud-tracked wind summaries (supplied by Chris Velden) are available for IOPs 5-7. The remaining summaries will be supplied after they are made available to the TCM-90 Data Center.

4.1 IOP-1, Typhoon Winona

Many logistic and communication problems were being solved during the first IOP. Although communication problems prevented drifting buoy data from being received in real-time until 18 UTC 9 August, these data were available from the Local Users Terminal on Guam. There are some gaps in satellite coverage on 9

Table 4.1.2 Upper-air soundings during IOP-1

IOP-1, 90080812 - 90081000, TY WINONA

O = Real-time. # = Delayed data, X = Not available

		0808		0809				0810
NO.	STATION	12	18	00	06	12	18	00
BLOCK 45 (HONG KONG)								
1	45004	O	X	O	O	O	O	O
BLOCK 47 (KOREA)								
2	47122	O	O	O	O	O	O	O
3	47138	O	X	O	O	O	O	O
4	47158	O	X	O	O	O	O	O
5	47185	O	X	O	O	O	O	O
BLOCK 47 (JAPAN)								
6	47582	O	X	O	O	O	O	O
7	47590	O	X	O	O	O	O	O
8	47600	O	X	O	O	O	O	O
9	47646	O	X	O	O	O	O	O
10	47678	O	X	O	O	O	O	O
11	47744	O	X	O	O	O	O	O
12	47778	O	X	O	O	O	O	O
13	47807	O	X	O	O	O	O	O
14	47827	O	X	O	O	O	O	O
15	47909	O	X	O	O	O	O	O
16	47918	O	X	O	O	O	O	O
17	47936	O	X	O	O	O	O	O
18	47945	O	X	O	O	O	O	O
19	47971	O	X	O	O	O	X	O
20	47991	O	X	O	O	O	X	O
BLOCKS 48,96 (THAILAND, MALAYSIA)								
21	48327	O	X	O	O	O	O	O
22	48407	#	X	O	O	O	O	O
23	48455	O	X	O	O	O	O	O
24	48568	O	X	O	O	O	O	O
25	48615	O	X	O	O	O	O	O
26	48648	X	X	O	O	O	O	O
27	96413	O	X	O	X	O	#	O
28	96471	O	X	O	O	O	#	O

Table 4.1.2 (continued)

IOP-1 (continued)

		0808		0809				0810
NO.	STATION	12	18	00	06	12	18	00
BLOCKS 54,57,58,59 (PEOPLES REPUBLIC OF CHINA)								
29	54857	O	X	O	O	O	O	O
30	57083	O	X	O	O	O	O	O
31	57494	O	X	O	O	O	O	O
32	57972	O	X	O	O	O	O	O
33	58150	O	X	O	O	O	O	O
34	58457	O	X	O	O	O	O	O
35	58847	O	X	O	O	O	O	O
36	59316	O	X	O	O	O	O	O
37	59758	O	X	O	O	O	O	O
38	59981	O	X	O	O	O	O	O
BLOCK 98 (PHILIPPINES)								
39	98223	X	X	X	#	#	X	#
40	98327	O	O	O	O	O	X	O
41	98426	X	X	X	X	X	X	X
42	98444	X	X	X	#	#	#	#
43	98646	X	X	O	O	O	X	O
BLOCK 91 (PACIFIC ISLANDS, NATIONAL WEATHER SERVICE)								
44	91217	O	O	O	O	O	O	O
45	91232	#	#	#	#	#	#	#
46	91334	O	O	O	O	O	O	O
47	91408	O	O	O	#	O	#	O
48	91413	O	O	O	O	O	O	O
BLOCK 47 (IWO JIMA)								
49	47000	X	X	X	X	X	X	X
BLOCK 46 (TAIWAN)								
50	46685	X	O	O	O	O	O	O
51	46699	O	X	O	X	O	X	O
52	46734	X	#	#	O	O	O	O
53	46747	O	X	O	X	O	X	X
54	MOTOI	X	#	#	#	#	#	#
55	46780	X	#	#	#	#	#	#
56	46810	X	#	#	#	O	#	O
SHIPS								
1	ERIH	O	O	O	O	O	O	O
2	FREI	O	O	O	O	O	O	O
3	UHQS	O	O	O	O	O	O	O
4	UMAY	O	O	O	O	O	O	O
5	JBOA	X	X	O	O	O	O	O
6	JCCX	X	X	X	X	X	X	X

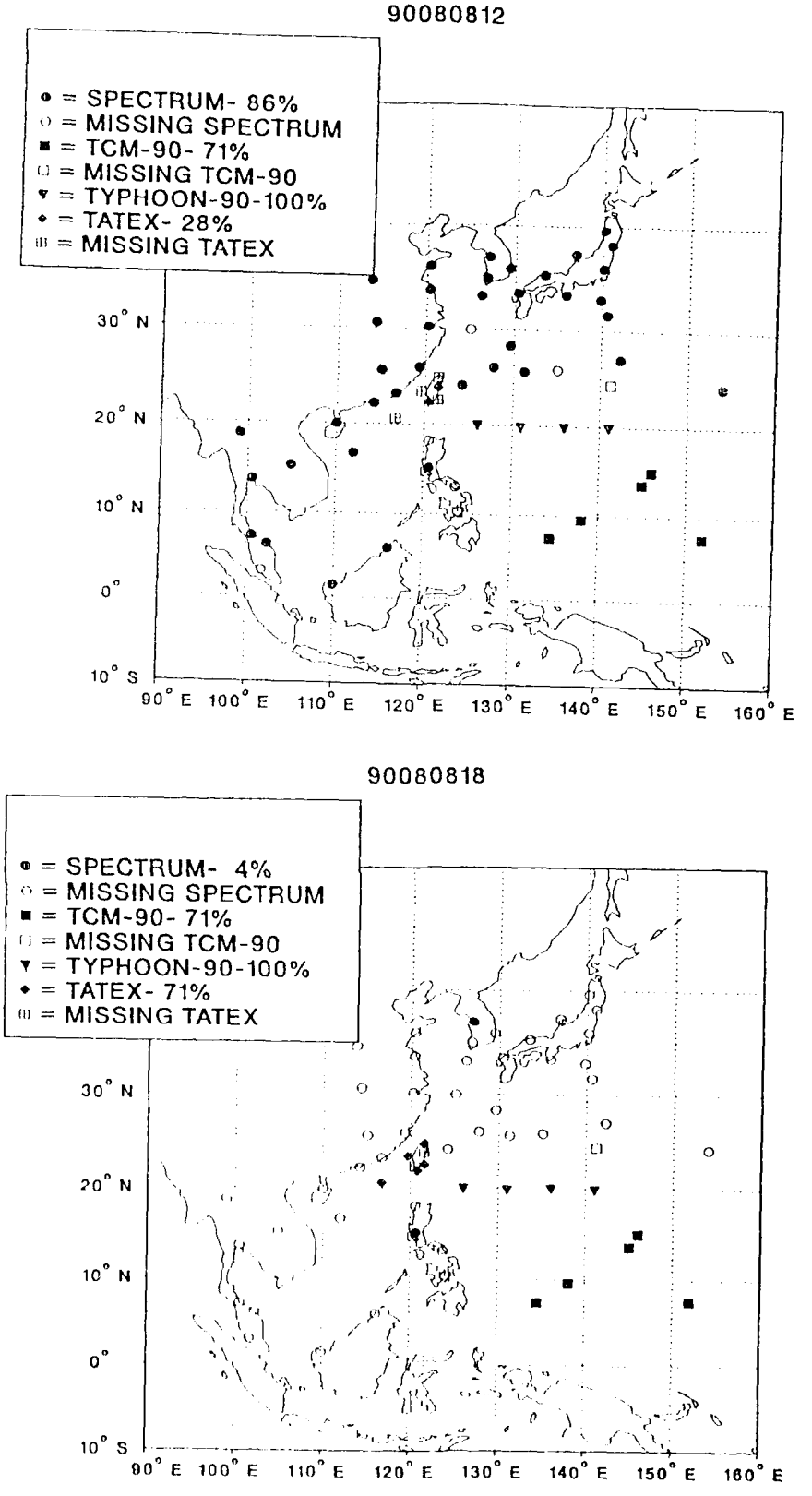
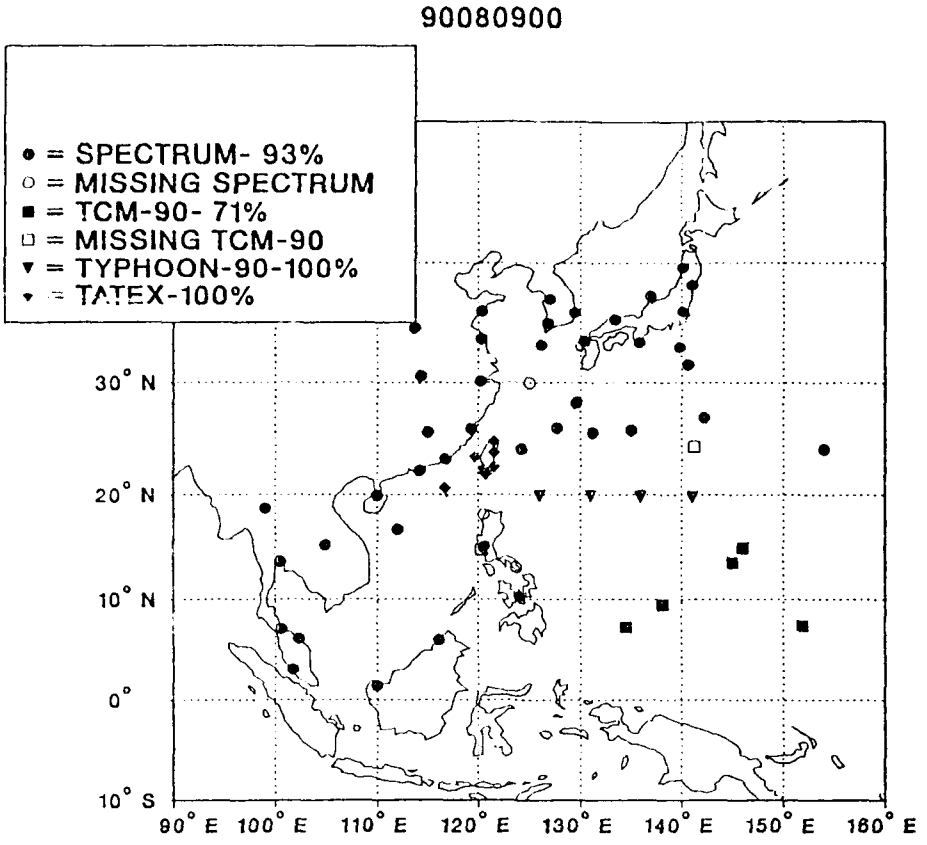


Figure 4.1 Spatial coverage of upper-air soundings during IOP-1



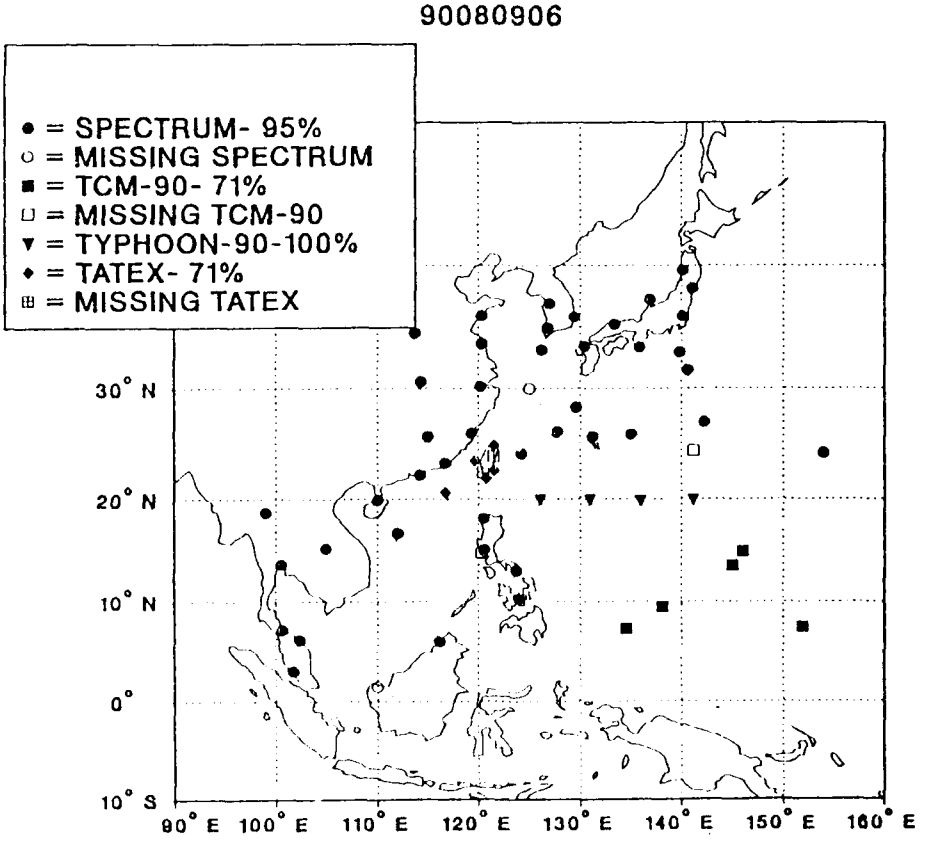
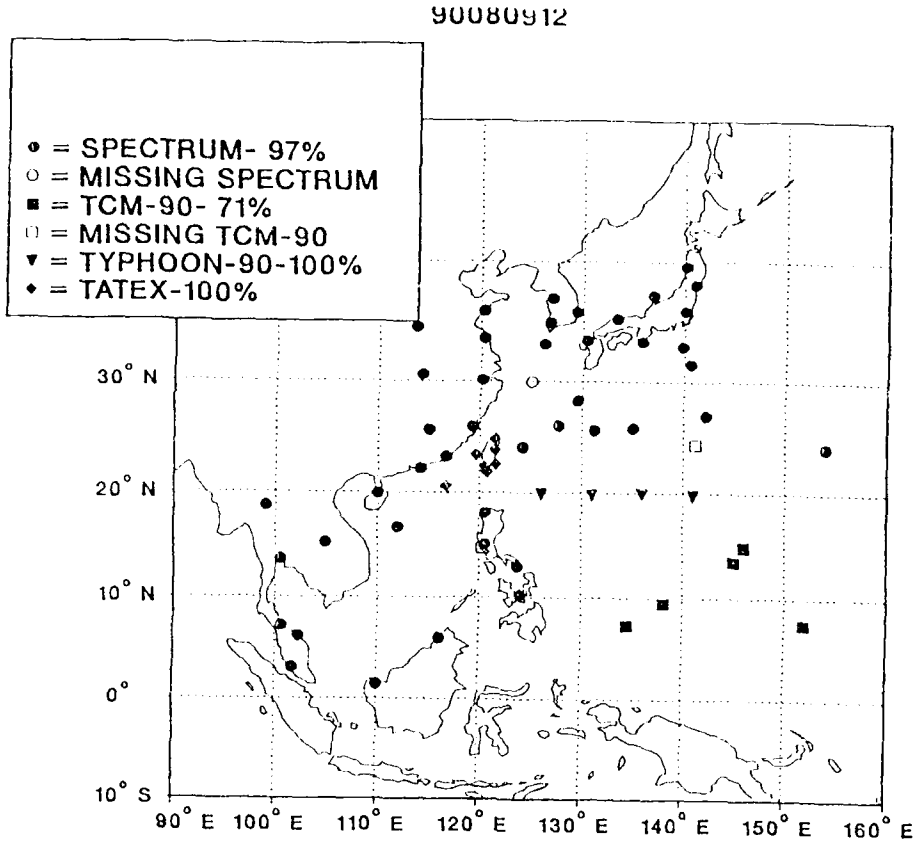


Figure 4.1 (continued)



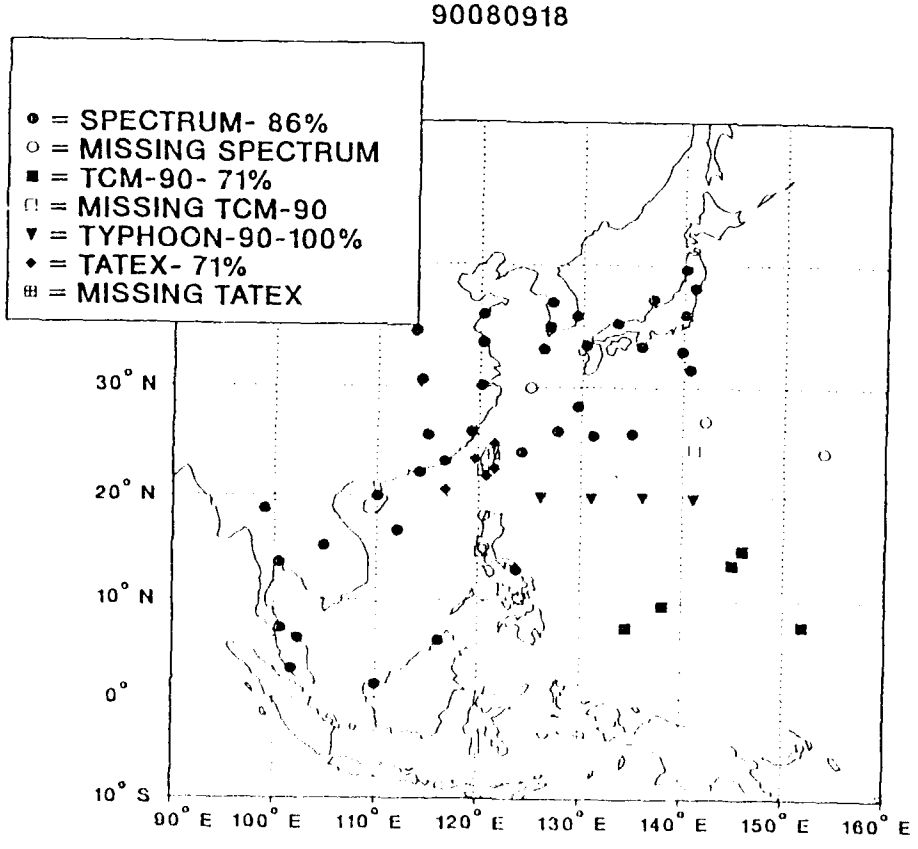


Figure 4.1 (continued)

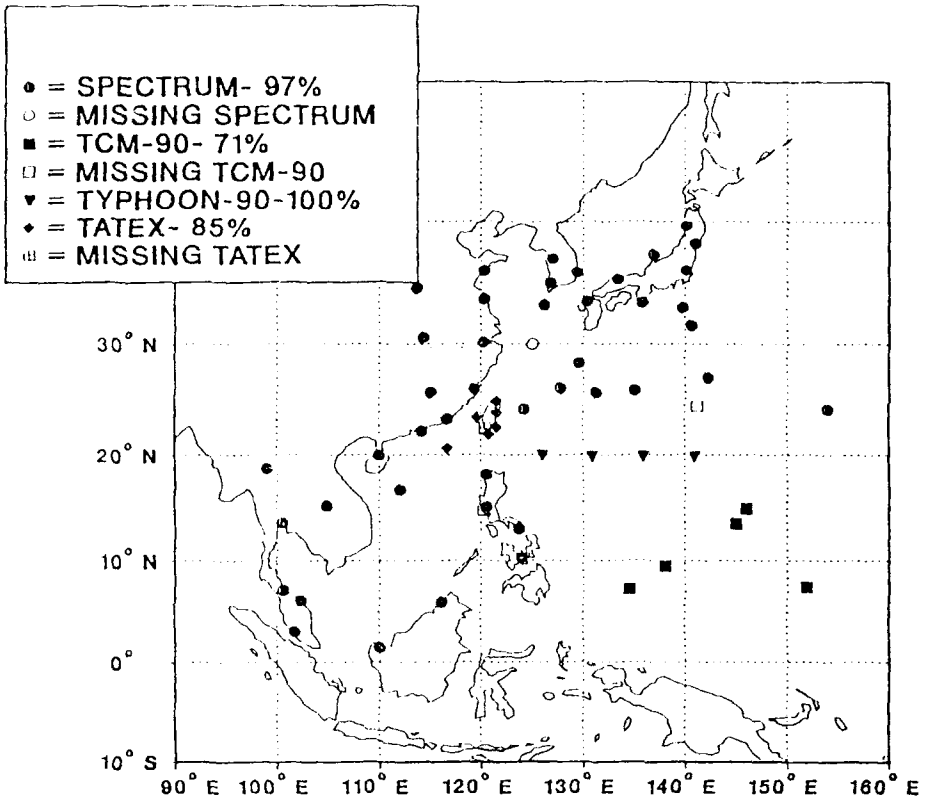


Figure 4.1 (continued)

4.2 IOP-2, Typhoon Yancy

A computer mainframe failure at the Australian Bureau of Meteorology resulted in no collection of GMS imagery during IOP-2. These data are being retrieved from Japan by the Bureau of Meteorology for use in reprocessing of the cloud-drift winds at the University of Wisconsin. These data will be supplied later as a supplemental data set.

Table 4.2.1 Satellite imagery summary for IOP-2

Date	Geostationary	Polar orbiting
15 Aug	No GMS	17 UTC NOAA11 pa 09 UTC DMSP8 pass
16 Aug	No GMS	10 UTC NOAA10 pass 05 & 17 UTC NOAA11 passes 22 UTC DMSP8 pass
17 Aug	No GMS	10 UTC DMSP8 pass

Table 4.2.2 Upper-air soundings during IOP-2

IOP-2, 90081512 - 90081712. TY YANCY

O = Real time, O + h = h hours after time, # = Delayed data, X = Not available

		0815		0816				0817		
NO.	STATION	12	18	00	06	12	18	00	06	12
BLOCK 45 (HONG KONG)										
1	45004	O	O	O	O	O	O	O	O	O
BLOCK 47 (KOREA)										
2	47122	O	O	O	O	O	O	O	O	O
3	47138	O	O	O	O	O	O	O	O	O
4	47158	O	O	O	O	O	O	O	O	
5	47185	O	O	O	O	O	O	O	O	O
BLOCK 47 (JAPAN)										
6	47582	O	O	O	O	O	O	O	O	O
7	47590	O	O	O	O	O	O	O	O	O
8	47600	O	O	O	O	O	O	O	O	O
9	47646	O	O	O	O	O	O	O	O	O
10	47678	O	O	O	O	O	O	O	O	O
11	47744	O	O	O	O	O	O	O	O	O
12	47778	O	O	O	O	O	O	O	O	O
13	47807	O	O	O	O	O	O	O	O	O
14	47827	O	O	O	O	O	O	O	O	O
15	47909	O	O	O	O	O	O	O	O	O
16	47918	O	O	O	O	O	O	O	O	O
17	47936	O	O	O	O	O	O	O	O	O
18	47945	O	O	O	O	O	O	O	O	O
19	47971	O	X	O	O	O	X	O	O	O
20	47991	O	X	O	O	O	X	O	O	X
BLOCKS 43,9[illegible] (THAILAND, MALAYSIA)										
20	48327	O	O	O	O	O	O	O	O	O
22	48407	O	O	O	O	O	O	O	O	O
23	48455	O	O	O	O	O	O	O	O	O
24	48566	O	O	O	O	O	O	O	O	O
25	48615	O	O	O	O	O	O	O	O	O
26	48548	O	O	O	O	O	O	O	O	O
27	96413	O	O	O	O	O	O	O	#	O
28	96471	O	X	#	O	O	O	O	O	O

Table 4.2.2 (continued)

TCP-2 (continued)

		0815		0816				0817		
NO.	STATION	12	18	00	06	12	18	00	06	12
BLOCKS 54,57,58,59 (PEOPLES REPUBLIC OF CHINA)										
29	54857	O	O	O	O	O	O	O	O	O
30	57083	O	O	O	O	O	O	O	O	O
31	57494	O	O	O	O	O	X	O	O	O
32	57972	O	O	O	O	O	O	O	O	O
33	58150	O	O	O	O	O	O	O	O	O
34	58457	O	O	O	O	O	O	O	O	O
35	58847	O	O	O	O	O	O	O	O	O
3	59316	O	O	O	O	O	O	O	O	O
37	59758	O	O	O	O	O	O	O	O	O
38	59981	O	O	O	O	O	O	O	O	O
BLOCK 98 (PHILIPPINES)										
39	98223	X	#	#	#	#	#	#	#	#
40	98327	O	X	O	X	O	O	O	O	O
41	98426	X	X	X	X	X	X	X	O	X
42	98444	X	#	#	#	#	X	#	#	#
43	98646	X	O	O	O	O	O	O	O	O
BLOCK 91 (PACIFIC ISLANDS, NATIONAL WEATHER SERVICE)										
44	91217	O	O	O	O	O	O	O	O	O
45	91232	#	#	#	#	#	#	#	#	#
46	91334	O	O	O	O	O	O	O	O	O
47	91408	O	#	O	O	O	O	#	O	X
48	91413	O	O	O	O	O	O	O	O	O
BLOCK 47 (IWO JIMA)										
49	47000	O	X	X	#	O	X	O	X	O
BLOCK 46 (TAIWAN)										
50	46685	X	X	O	O	O	O	O	O	O
51	46699	O	X	O	X	O	X	O	X	O
52	46734	O	X	O	O	O	O	O	O	O
53	46747	O	X	O	X	O	X	O	X	O
54	MOTO1	X	X	X	X	#	X	#	X	X
55	46780	X	X	X	#	#	#	#	#	#
56	46810	X	X	X	X	O	X	X	X	X
SHIPS										
1	EPEH	O	O	O	O	O+1	O	O+1	O	O
2	ERLI	O	X	O	X	O+2	O	O	O	O
3	UHQS	O	O	O	O	O	O	O	O	O
4	UMAY	O	O	O	O	O	O	O	O	O
5	IBOA	X	X	X	O	O	O	O	O	O
6	ICCX	O	O	O	O	O	O	O	O	O

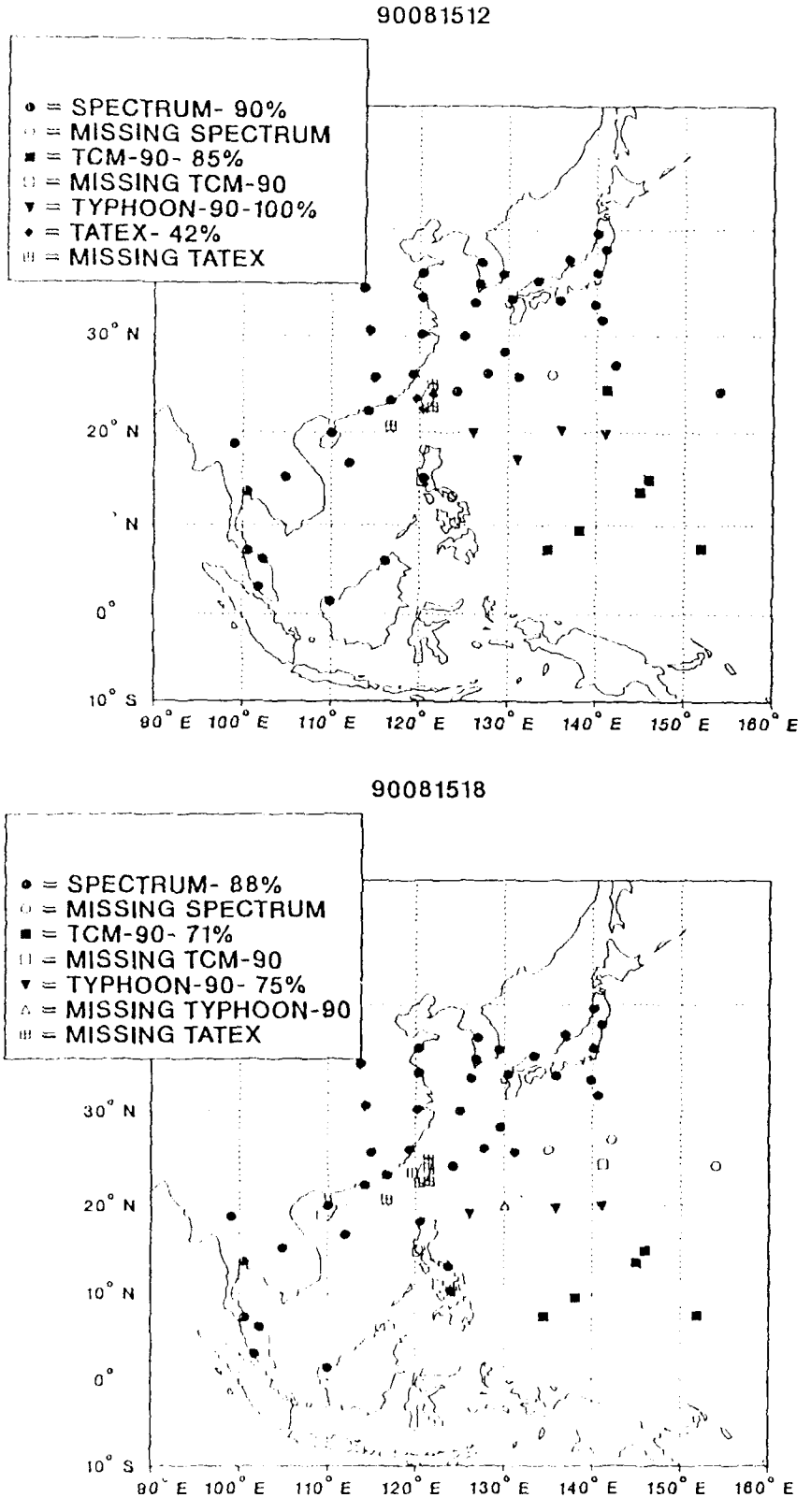
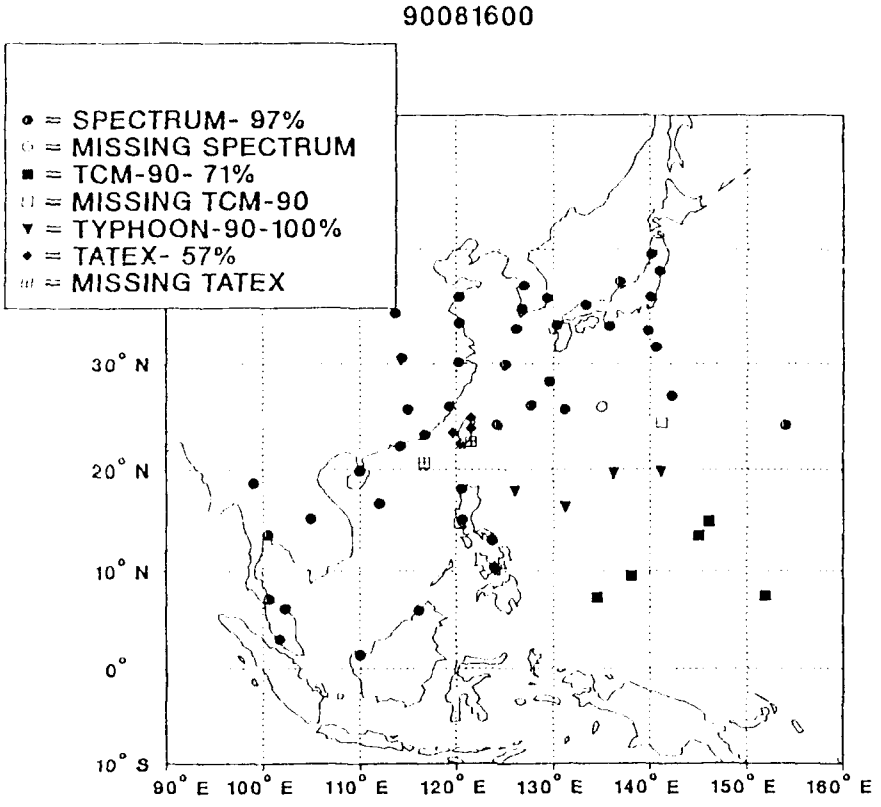


Figure 4.2 Spatial coverage of upper-air soundings during IOP-2



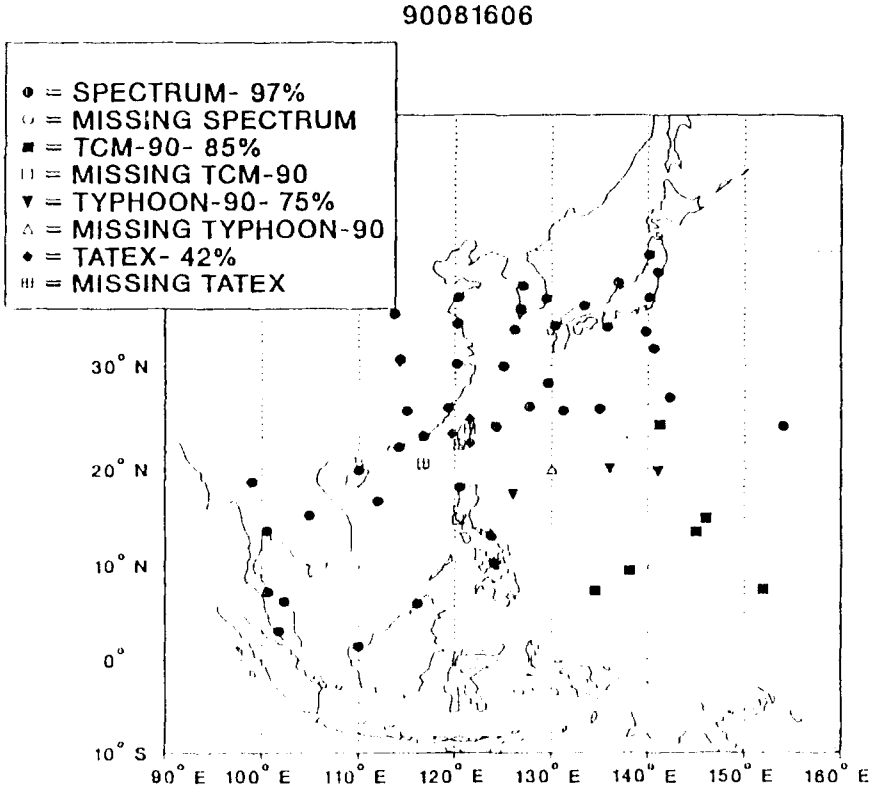
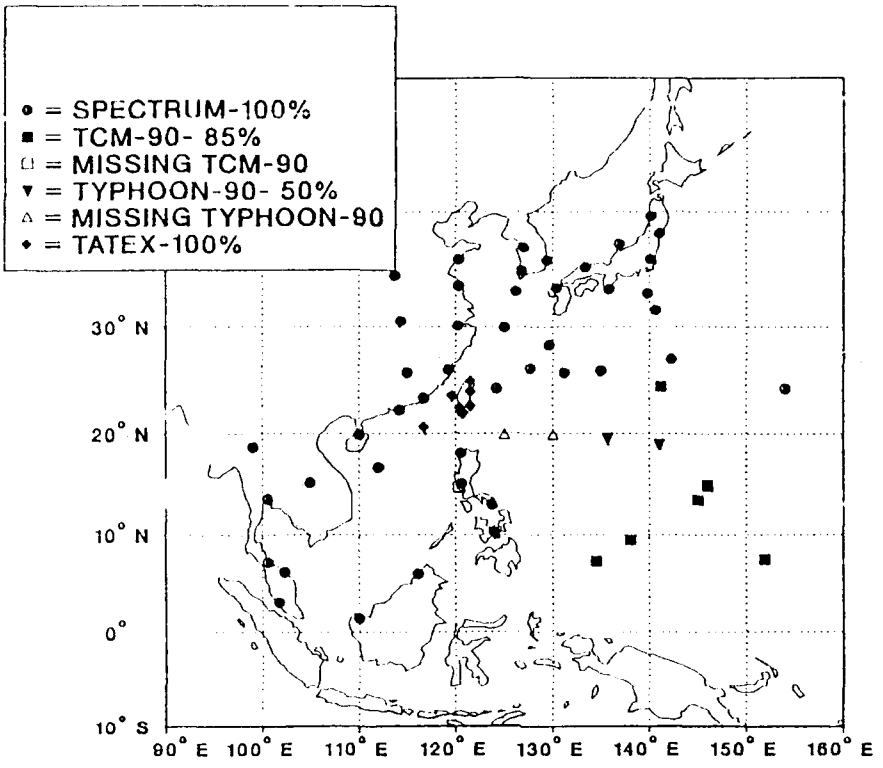


Figure 4.2 (continued)

90081612



90081618

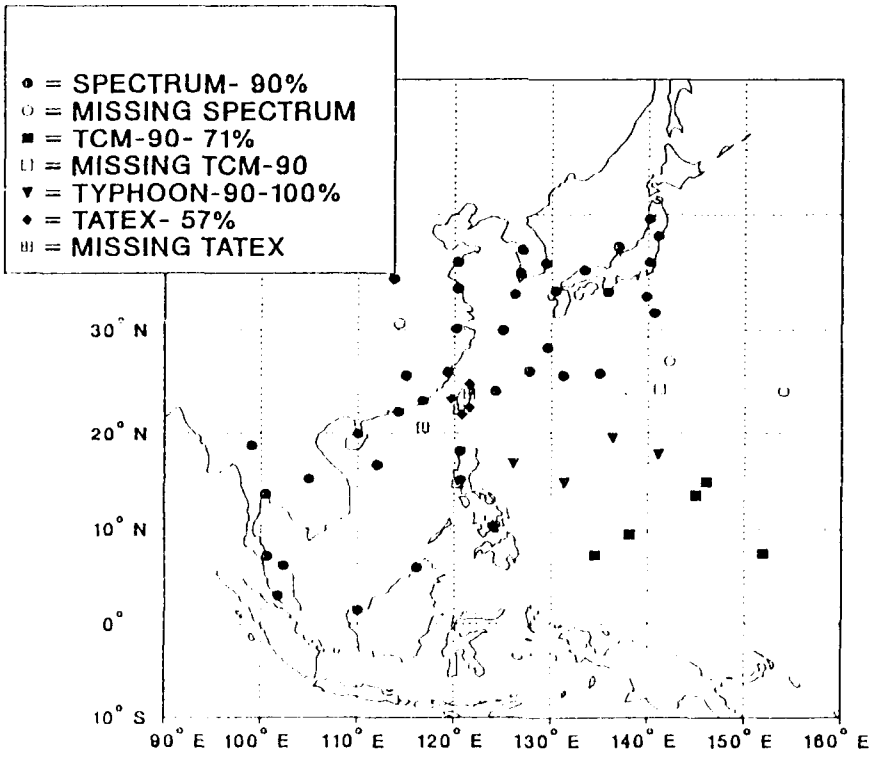
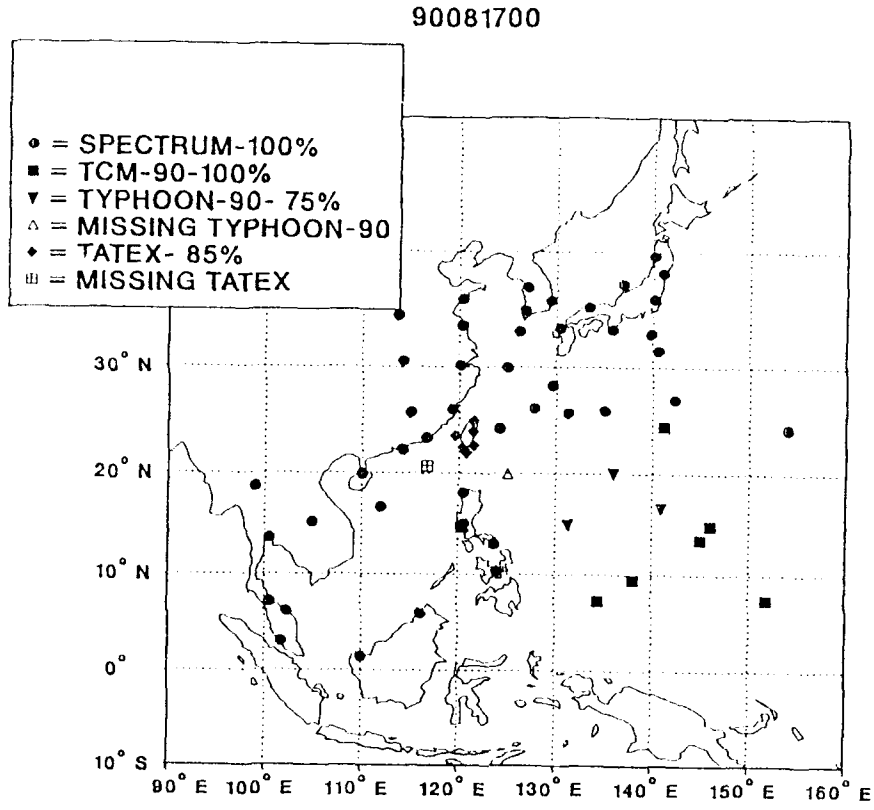


Figure 4.2 (continued)



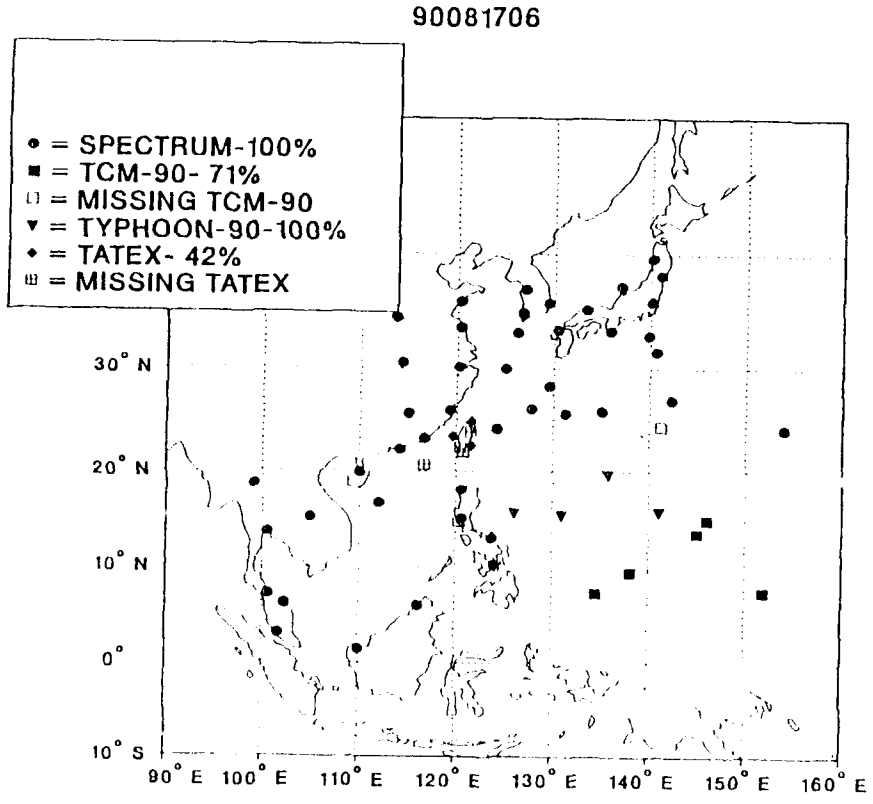


Figure 4.2 (continued)

90081712

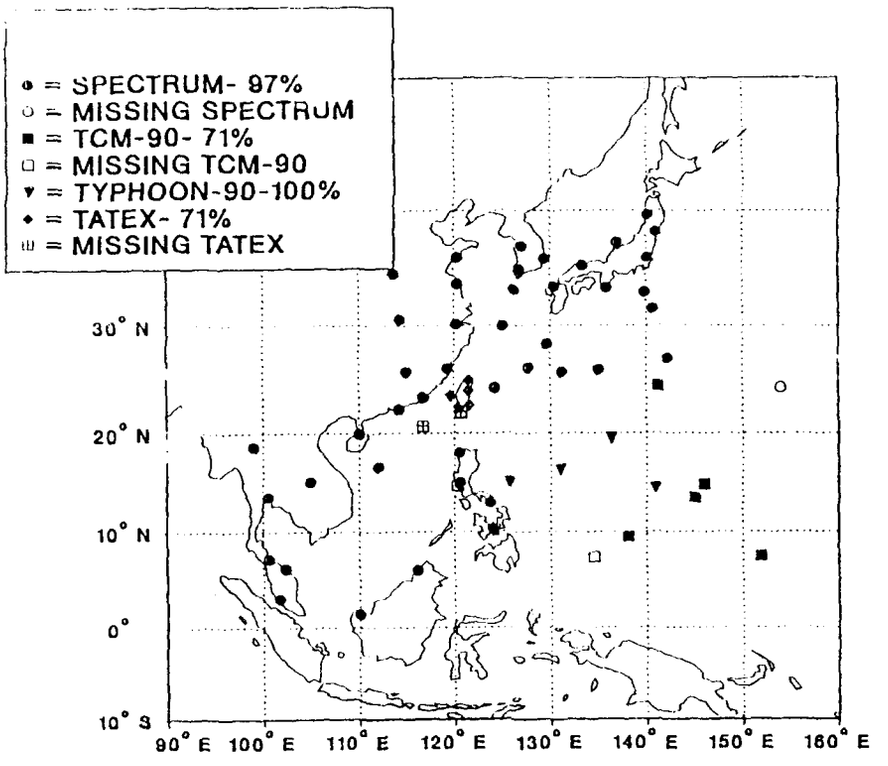


Figure 4.2 (continued)

4.3 IOP-3, Typhoon Yancy/Typhoon Zola

The computer mainframe failure at the Bureau of Meteorology also prevented collection of GMS imagery during IOP-3. Efforts are currently in progress to recover the data for both IOP 2 and 3. Additionally, a lightning strike at the University of Wisconsin on the afternoon of 18 August prevented collection of polar orbiting satellite data. The real-time satellite sounding data were collected at FNOC.

Table 4.3.1 Satellite imagery summary for IOP-3

Date	Geostationary	Polar orbiting
18 Aug	No GMS	No DMSP or NOAA
19 Aug	No GMS	No DMSP or NOAA

Table 4.3.2 Upper-air soundings during IOP-3

IOP-3, 90081800 - 90082000, TY YANCY, TY ZOLA

O = Real-time, # = Delayed data, X = Not available.

		0818				0819				0820
NO.	STATION	00	06	12	18	00	06	12	18	00
BLOCK 45 (HONG KONG)										
1	45004	O	O	O	O	O	O	O	O	O
BLOCK 47 (KOREA)										
2	47122	O	O	O	O	O	O	O	O	O
3	47138	O	O	O	O	O	O	O	O	O
4	47158	O	O	O	O	O	O	O	O	O
5	47185	O	O	O	O	O	O	O	O	O
BLOCK 47 (JAPAN)										
6	47582	O	O	O	O	O	O	O	O	O
7	47590	O	O	O	O	O	O	O	O	O
8	47600	O	O	O	O	O	O	O	O	O
9	47646	O	O	O	O	O	O	O	O	O
10	47678	O	O	O	O	O	O	O	O	O
11	47744	O	O	O	O	O	O	O	O	O
12	47778	O	O	O	O	O	O	O	O	O
13	47807	O	O	O	O	O	O	O	O	O
14	47827	O	O	O	O	O	O	O	O	O
15	47909	O	O	O	O	O	O	O	O	O
16	47918	O	O	O	O	O	O	O	O	O
17	47936	O	O	O	O	O	O	O	O	O
18	47945	O	O	O	O	O	O	O	O	O
19	47971	O	X	O	X	O	X	O	X	O
20	47991	O	X	O	X	O	X	O	X	O
BLOCKS 48,96 (THAILAND, MALAYSIA)										
21	48327	O	O	O	O	O	O	O	O	O
22	48407	O	O	O	O	O	O	O	O	O
23	48455	O	O	O	O	O	O	O	O	O
24	48568	O	O	O	O	O	O	O	O	O
25	48615	O	O	O	O	O	O	O	X	O
26	48648	O	O	O	O	O	O	O	X	O
27	96413	O	O	O	O	O	O	O	X	O
28	96471	O	O	O	O	O	O	O	O	O

Table 4.3.2 (continued)

IOP-3 (continued)

		0818				0819				0820
NO.	STATION	00	06	12	18	00	06	12	18	00
BLOCKS 54,57,58,59 (PEOPLES REPUBLIC OF CHINA)										
29	54857	O	O	O	O	O	O	O	O	O
30	57083	O	O	O	O	O	O	O	O	O
31	57494	O	O	O	O	O	O	O	O	O
32	57972	O	O	O	O	O	O	O	O	O
33	58150	O	O	O	O	O	O	O	O	O
34	58457	O	O	O	O	O	O	O	O	O
35	58847	O	O	O	O	O	O	O	O	O
36	59316	O	O	O	O	O	O	O	O	O
37	59758	O	O	O	O	O	O	O	O	O
38	59981	O	O	O	O	O	O	O	O	O
BLOCK 98 (PHILIPPINES)										
39	98223	#	X	X	X	#	X	X	X	#
40	98327	O	O	O	X	O	X	O	X	O
41	98426	X	X	X	O	X	#	X	O	X
42	98444	#	X	#	#	#	#	#	#	#
43	98646	O	X	O	O	O	O	O	O	O
BLOCK 91 (PACIFIC ISLANDS, NATIONAL WEATHER SERVICE)										
44	91217	O	O	O	O	O	O	O	O	O
45	91232	#	#	#	#	#	X	#	X	#
46	91334	O	X	#	X	O	X	O	X	O
47	91408	O	X	O	X	O	X	O	X	#
48	91413	O	X	O	X	O	X	O	X	O
BLOCK 47 (IWO JIMA)										
49	47000	O	X	O	O	O	O	X	X	X
BLOCK 46 (TAIWAN)										
50	46685	O	O	O	O	O	X	O	O	O
51	46699	O	#	O	O	O	O	O	#	O
52	46734	O	#	O	O	O	O	O	#	O
53	46747	O	O	O	#	#	O	O	O	#
54	MOTOI	#	#	#	X	X	X	X	X	X
55	46780	#	X	X	X	X	X	X	X	X
56	46810	X	X	X	X	O	O	O	#	O
SHIPS										
1	EREH	O	O	O	O	O	O	O	O	O
2	EREI	O	O	O	O	O	O	O	O	O
3	UHQS	O	#	O	O	O	O	O	#	O
4	UMAY	O	X	O	O	O	#	O	O	X
5	JBOA	O	O	O	O	O	#	O	O	O
6	JCCX	O	O	#	O	O	#	O	O	O

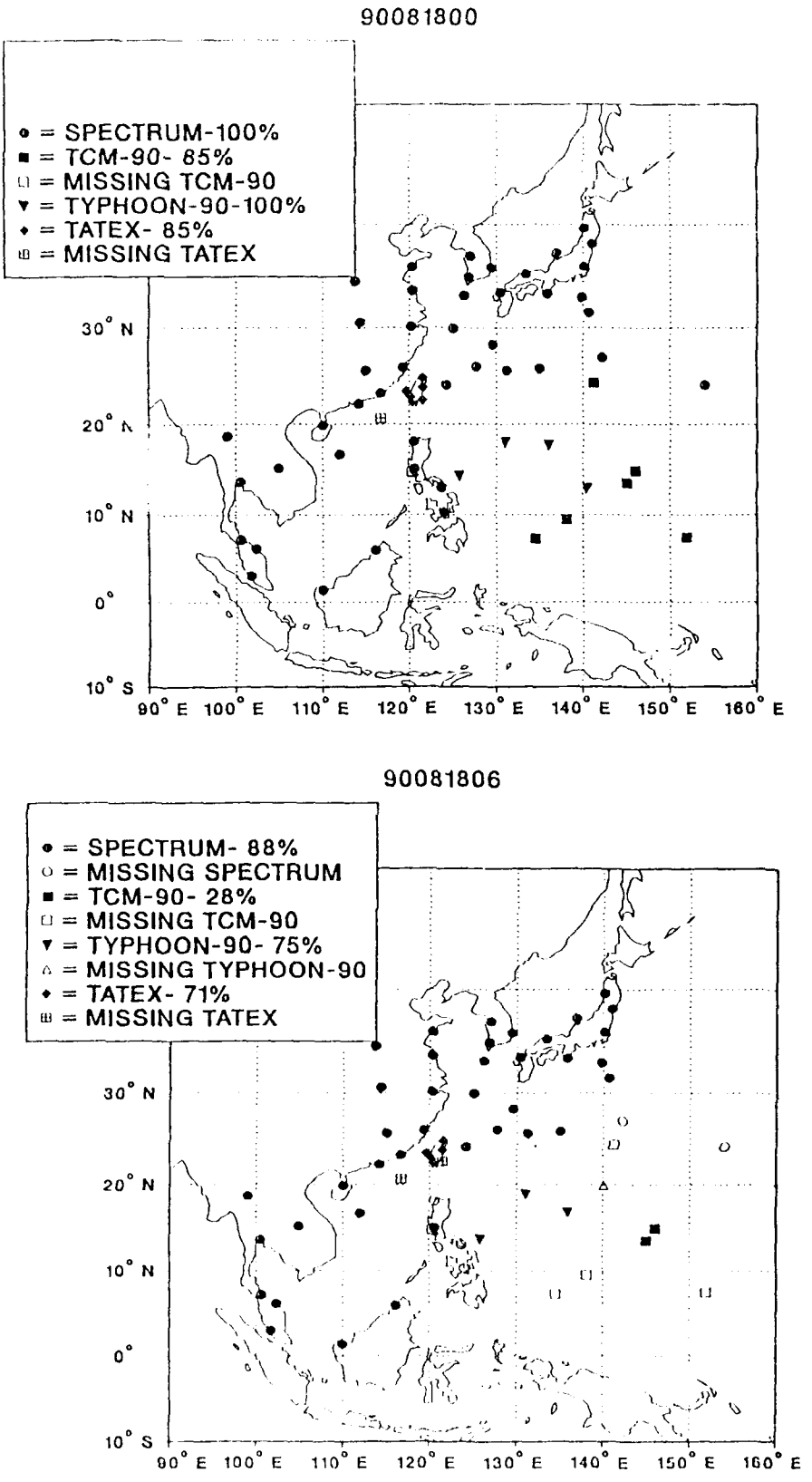
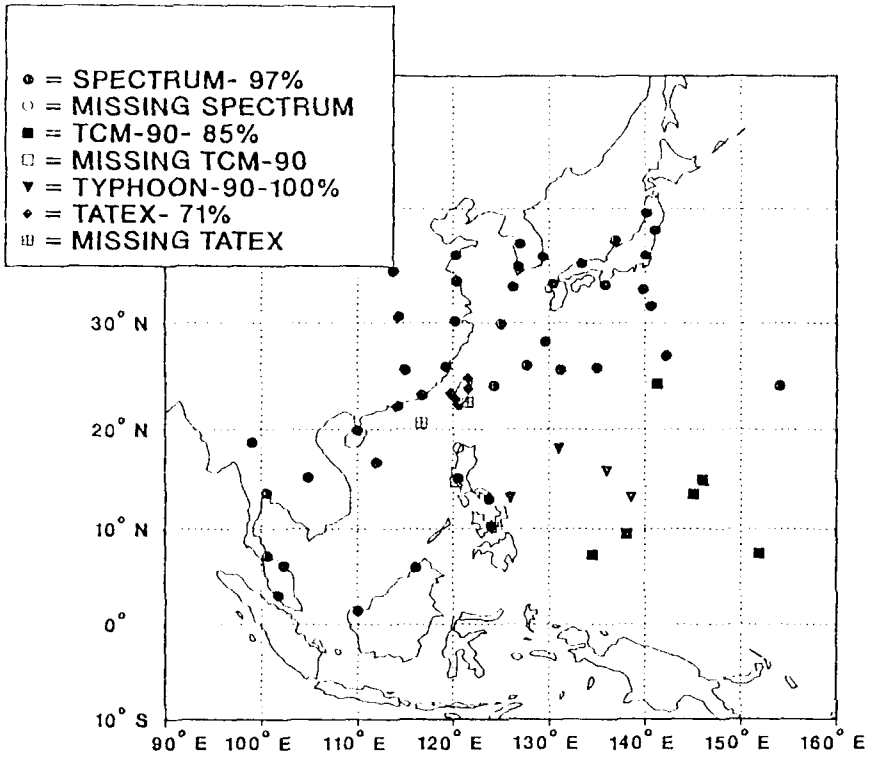


Figure 4.3 Spatial coverage of upper-air soundings during IOP-3

90081812



90081818

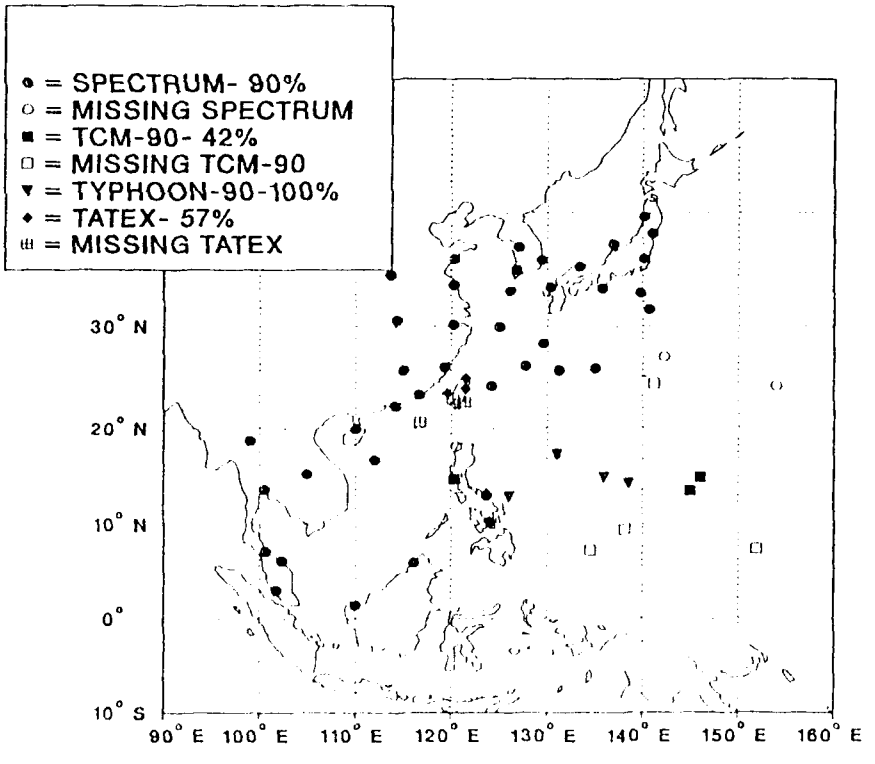
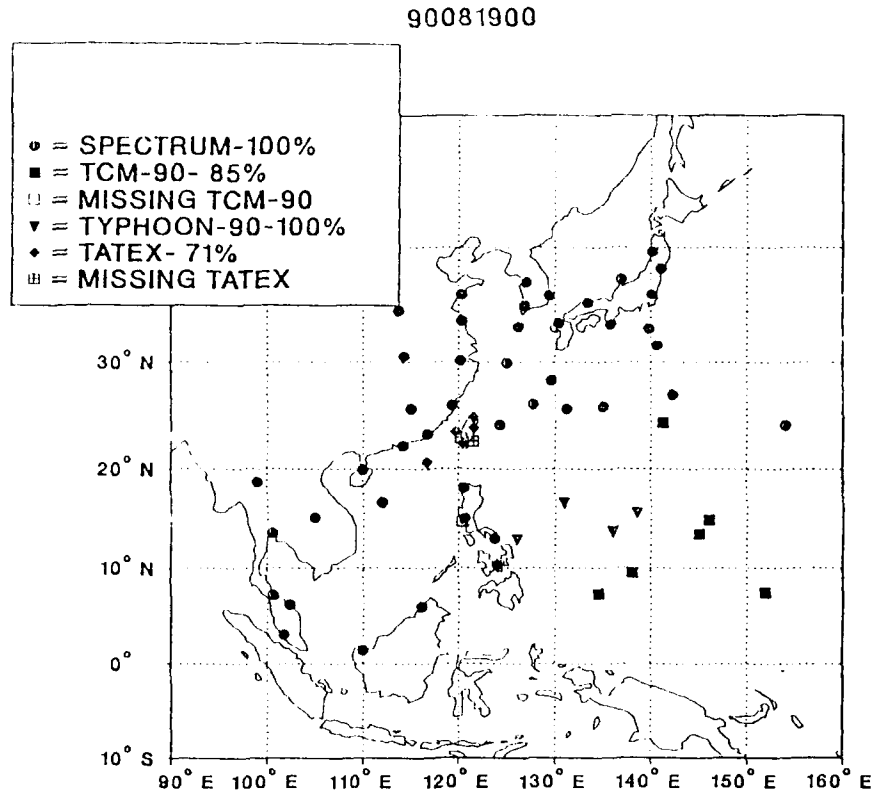


Figure 4.3 (continued)



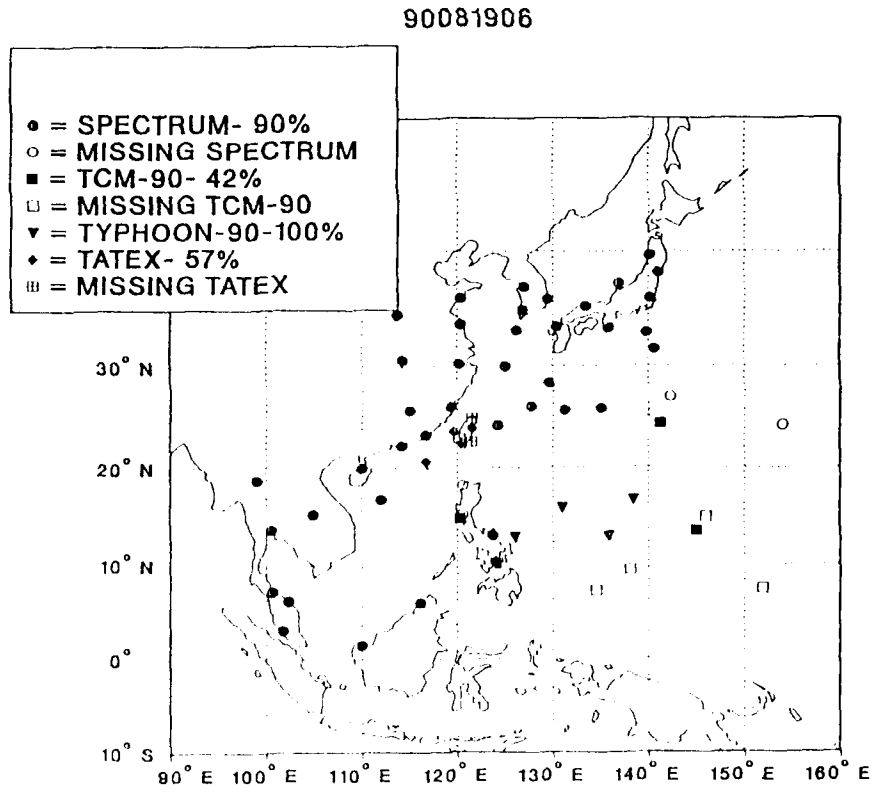
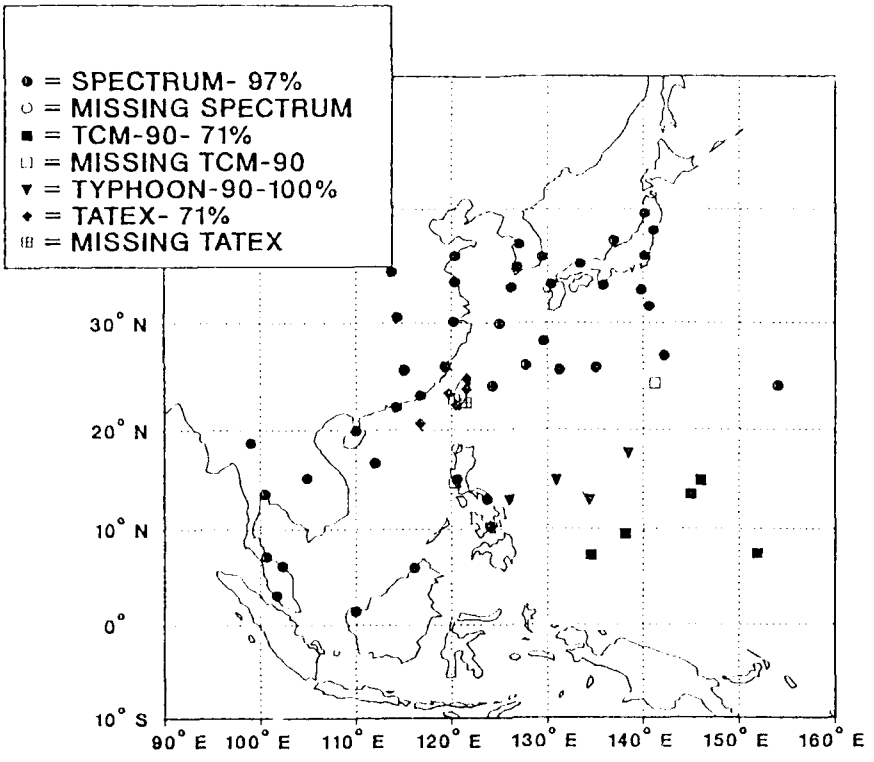


Figure 4.3 (continued)

90081912



90081918

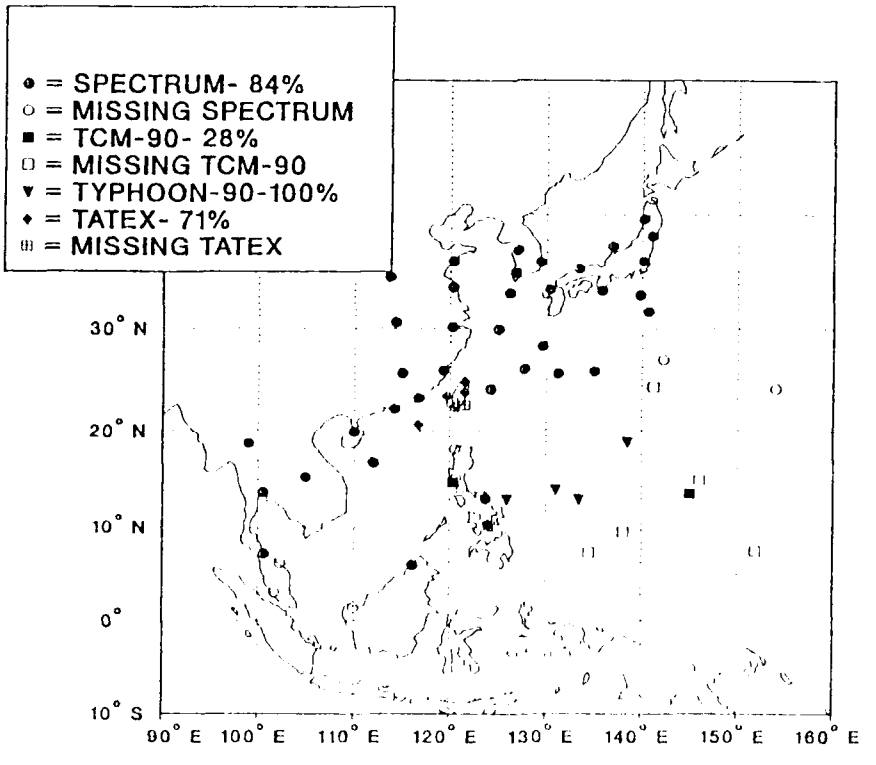


Figure 4.3 (continued)

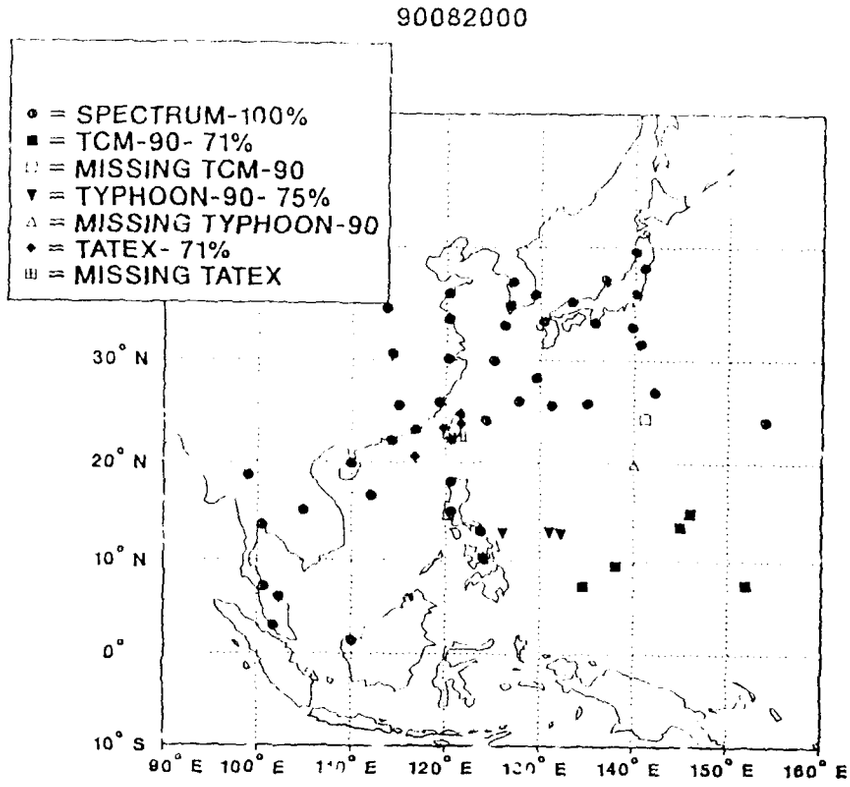


Figure 4.3 (continued)

4.4 IOP-4, Typhoon Dot

No observations from the SPECTRUM stations are available for 18 UTC 5 September because SPECTRUM did not start their IOP until 00 UTC 6 September. Also, due to a failure in communications, the Pacific Island stations did not take observations at 18 UTC 5 September. Consequently, the TCM-90 IOP was extended until 00 UTC 8 September.

Three-hourly observations are available from many of the TATE stations between 18 UTC 6 September and 00 UTC 8 September.

A DC-8 flight was made into Dot on 6 September. Unfortunately, the LORAN problems (see Section 2.2.8) resulted in very few wind observations on the dropwindsondes launched on this flight. Although a second flight was made on 7 September, only flight-level data are available.

Table 4.4.1 Satellite imagery summary for IOP-4

Date	Geostationary	Polar Orbiting
5 Sep	All GMS	17 UTC NOAA11 pass 09 UTC DMSP8 pass
6 Sep	All GMS	09 & 23 UTC NOAA11 passes 05 & 18 UTC NOAA11 passes 11 & 22 UTC DMSP8 passes
7 Sep	All GMS	09 UTC NOAA10 pass 22 UTC DMSP8 pass

Table 4.4.2 Dropwindsonde data summary for IOP-4

Date	Initial press[1]	Dual temp[2]	Final press	Final temp	Final altitude	Percent winds
9060005	0	1	918.4	26.1		0
9060036	0	1	1014.7	28.9	-81.5	0
9060120	0	1	1014.9	29.1	-92.4	50
9060131	1	0	(1091.)	25.2		0
9060153	1	1	1007.3	29.1	-79.2	40
9060206	1	1	1001.2	27.5	-36.8	0

[1] '0' indicates that the initial pressure is correct from launch
'1' indicates that the pressure from the first few seconds after launch is below calibrated range.

[2] '0' indicates that there were no dual temperatures.
'1' indicates that there were dual temperatures.

Table 4.4.3 Upper-air soundings during IOP-4

IOP-4, 90090512 - 90090800, TY DOT

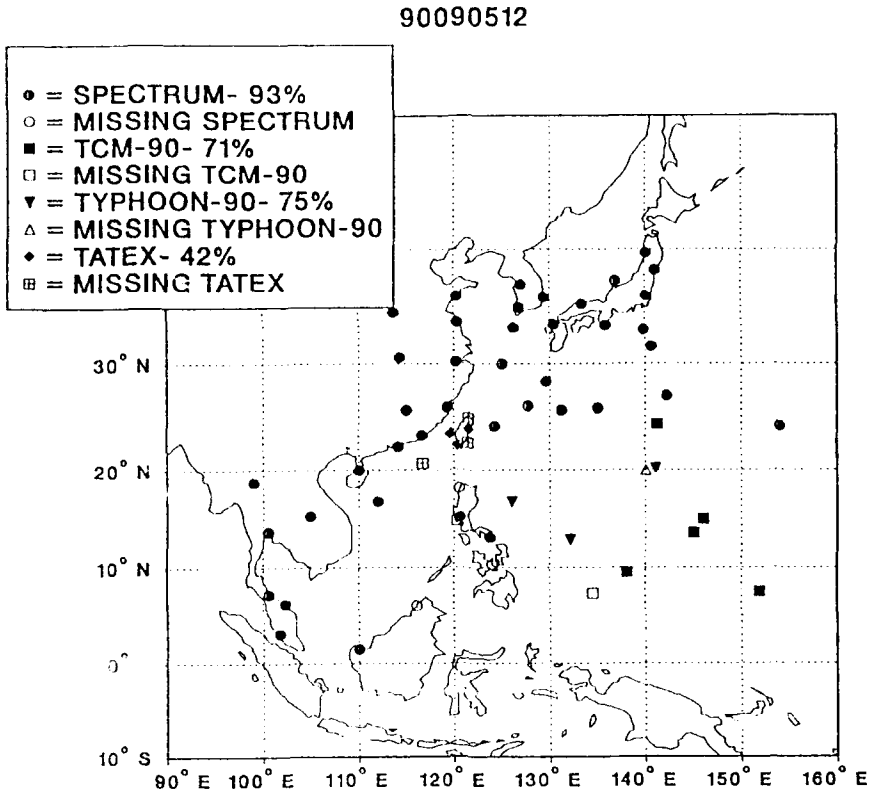
O = Real-time, O + h = h hours after time, # = Delayed data, X = Not available

		0905		0906				0907				0908
NO.	STATION	12	18	00	06	12	18	00	06	12	18	00
BLOCK 45 (HONG KONG)												
1	45004	O	O	O	O	O	O	O	O	O	O	O
BLOCK 47 (KOREA)												
2	47122	O	O	O	O	O	O	O	O	O	O	O
3	47138	O	X	O	O	O	O	O	O	O	O	O
4	47158	O	X	O	O	O	O	O	O	O	O	O
5	47185	O	X	O	O	O	O	O	O	O	O	O
BLOCK 47 (JAPAN)												
6	47582	O	O	O	O	O	O	O	O	O		
7	47590	O	X	O	O	O	O	O	O	O	O	O
8	47600	O	X	O	O	O	O	O	O	O	O	O
9	47646	O	X	O	O	O	O	O	O	O	O	O
10	47678	O	X	O	O	O	O	O	O	O	O	O
10	47744	O	X	O	O	O	O	O	O	O	O	O
12	47778	O	X	O	O	O	O	O	O	O	O	O
13	47807	O	X	O	O	O	O	O	O	O	O	O
14	47827	O	X	O	O	O	O	O	O	O	O	O
15	47909	O	X	O	O	O	O	O	O	O	O	O
16	47918	O	X	O	O	O	O	O	O	O	O	O
17	47936	O	X	O	O	O	O	O	O	O	O	O
18	47945	O	X	O	O	O	O	O	O	O	O	O
19	47971	O	X	O	O	O	X	O	O	O	X	O
20	47991	O	X	O	O	O	X	O	O	O	X	O
BLOCKS 48,96 (THAILAND, MALAYSIA)												
21	48327	O	X	O	O	X	O	O	O	O	O	O
21	48407	O	X	O	O	O	O	O	O	O	O	O
23	48455	O	X	O	O	O	O	O	O	O	O	O
24	48568	O	X	O	O	O	O	O	O	O	O	O
25	48615	O	X	O	X	O	O	O	O	O	O	#
26	48648	O	X	O	#	O	O	O	O	O	O	O
27	96413	O	X	O	#	O	O	O	O	X	O	#
28	96471	X	X	O	#	O	O	O	O	O	O	O

Table 4.4.3 (continued)

IOP-4 (continued)

		0905		0906				0907				0908
NO.	STATION	12	18	00	06	12	18	00	06	12	18	00
BLOCKS 54,57,58,59 (PEOPLES REPUBLIC OF CHINA)												
29	54857	O	X	O	O	O	O	O	O	O	O	O
30	57083	O	X	O	O	O	O	O	O	O	O	O
31	57494	O	X	O	O	O	O	O	O	O	O	O
32	57972	O	X	O	O	O	O	O	O	O	O	O
33	58150	O	X	O	O	O	O	O	O	O	O	O
34	58457	O	X	O	O	O	O	O	O	O	O	O
35	58847	O	X	O	O	O	O	O	O	O	O	O
36	59316	O	X	O	O	O	O	O	O	O	O	O
37	59758	O	X	O	O	O	O	O	O	O	O	O
38	59981	O	X	O	O	O	O	O	O	O	O	O
BLOCK 98 (PHILIPPINES)												
39	98223	X	X	O	X	O	X	O	O	O	X	O
40	98327	O	X	O	X	O	X	X	X	O	X	O
41	98426	X	O	X	#	X	#	X	#	X	O	X
42	98444	O	X	O	O	O	O	O	O	O	O	O
43	98646	X	X	O	O	#	O	O	O	O	O	O
BLOCK 91 (PACIFIC ISLANDS, NATIONAL WEATHER SERVICE)												
44	91217	O	X	O	O	O	O	O	O	O	O	O
45	91232	#	#	#	#	#	#	#	#	#	#	#
46	91334	O	X	O	O	O	O	O	O	O	O	O
47	91408	X	X	O	O	O	O	O	O	O	O	X
48	91413	O	X	O	O	O	O	O	#	O	X	O
BLOCK 47 (IWO JIMA)												
49	47000	O	X	O	#	O	X	#	#	#	#	#
BLOCK 46 (TAIWAN)												
50	46685	X	O	O	O	O	O	O	O	O	O	O
51	46699	O	X	O	X	O	O	O	O	O	X	X
52	46734	O	O	O	O	O	#	O	O	O	O	O
53	46747	O	X	O	X	O	O	X	O	O	O	O
54	MOTO1	X	#	#	#	#	X	#	#	#	#	#
55	46780	X	#	#	#	#	#	X	X	#	X	#
56	46810	X	#	O	#	#	O	#	#	#	#	#
SHIPS												
1	EREH	O	O	O	O	O	O	O	O	O	X	O
2	EREI	O	O	O	O	O	O	O	X	O	X	O
3	UHQS	O	O	O	O	O	O	O	O	O	X	O
4	UMAY	X	X	O	O	O	O	O	O	O	X	O
5	JBOA	O	X	O	O	O	O	O	O	O	O	O
6	JCCX	O	X	O	O	O	O	O	O	O	O	O



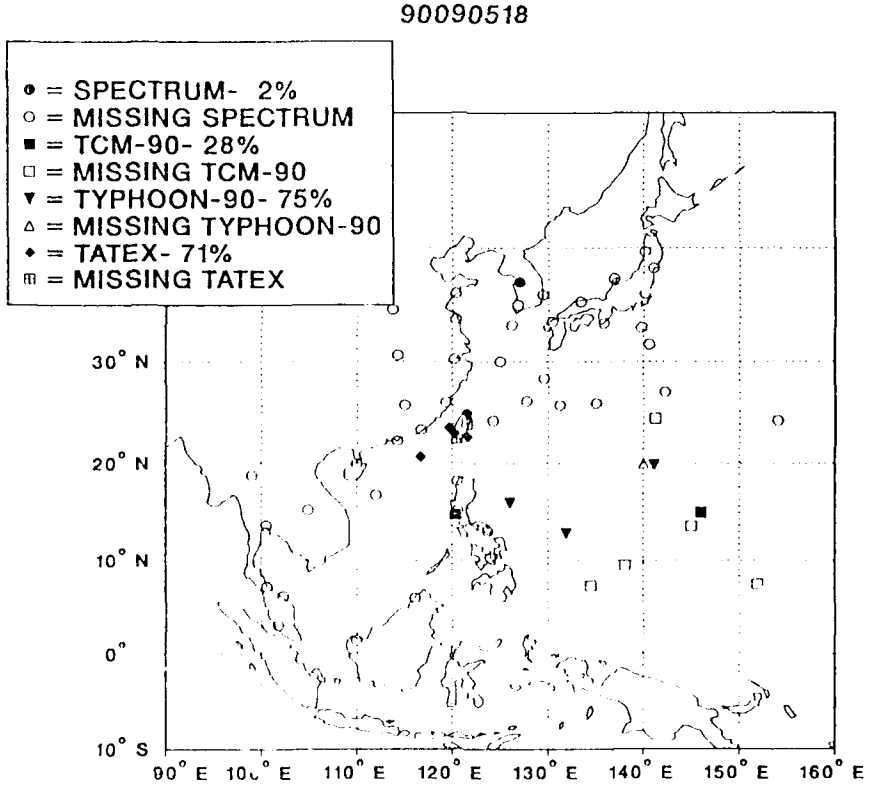
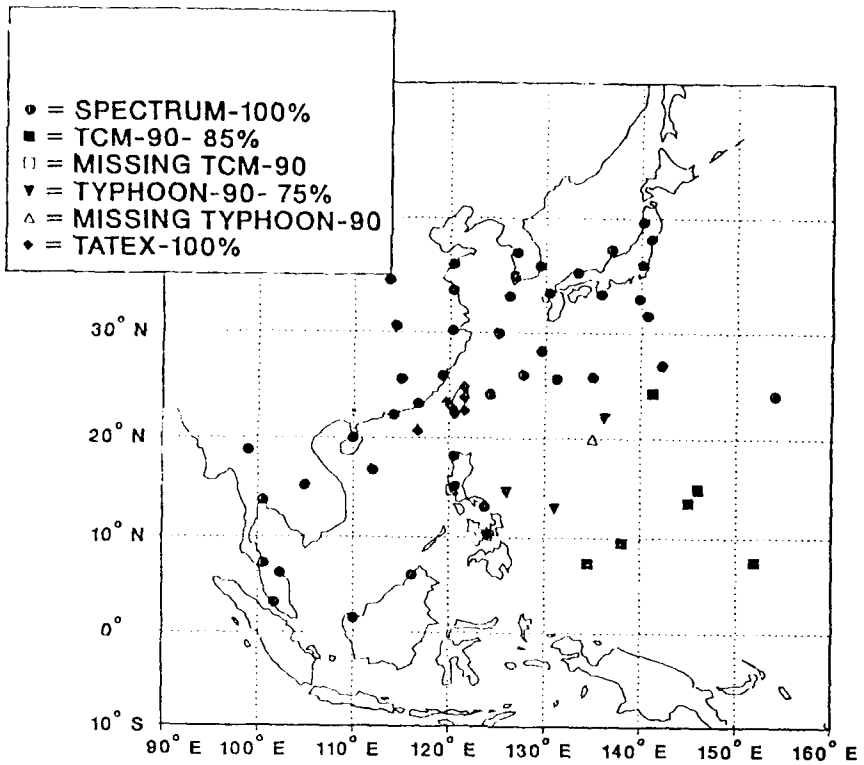


Figure 4.4 Spatial coverage of upper-air soundings during IOP-4

90090600



90090606

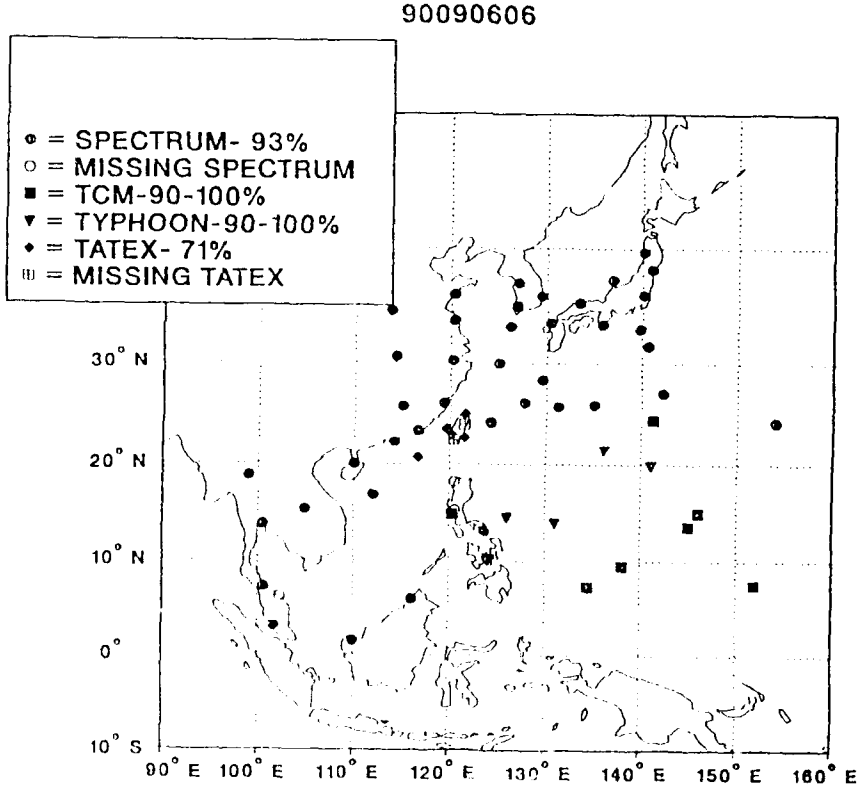
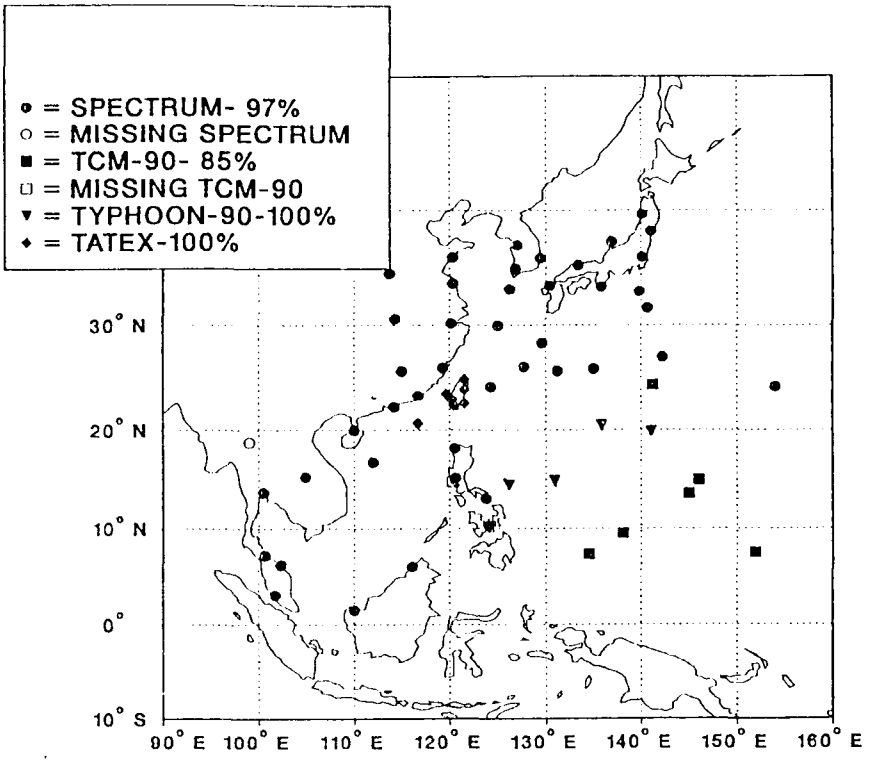


Figure 4.4 (continued)

90090612



90090618

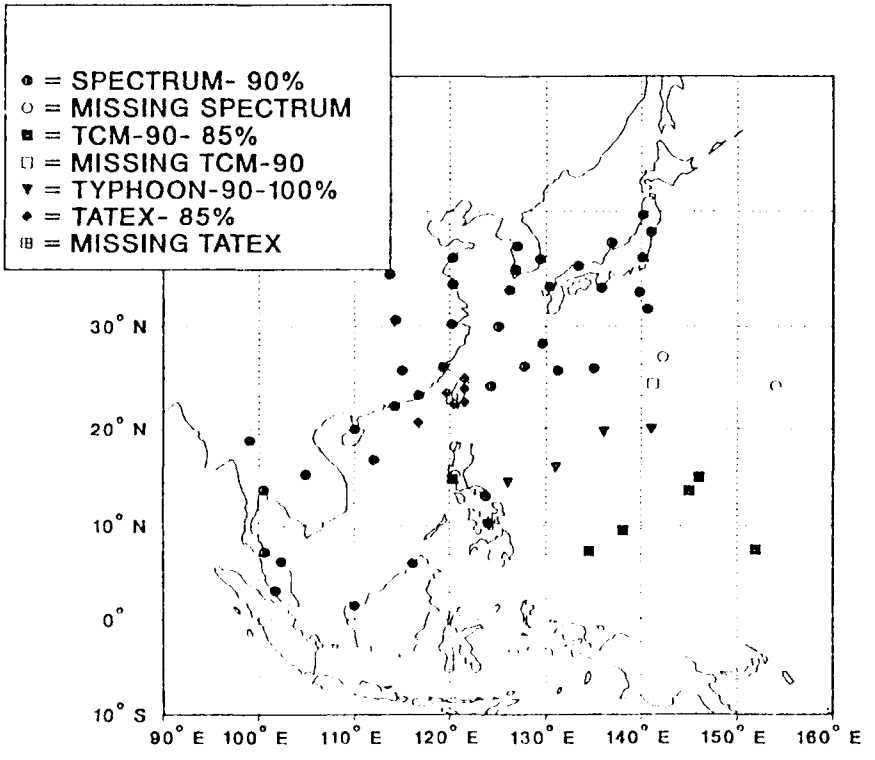
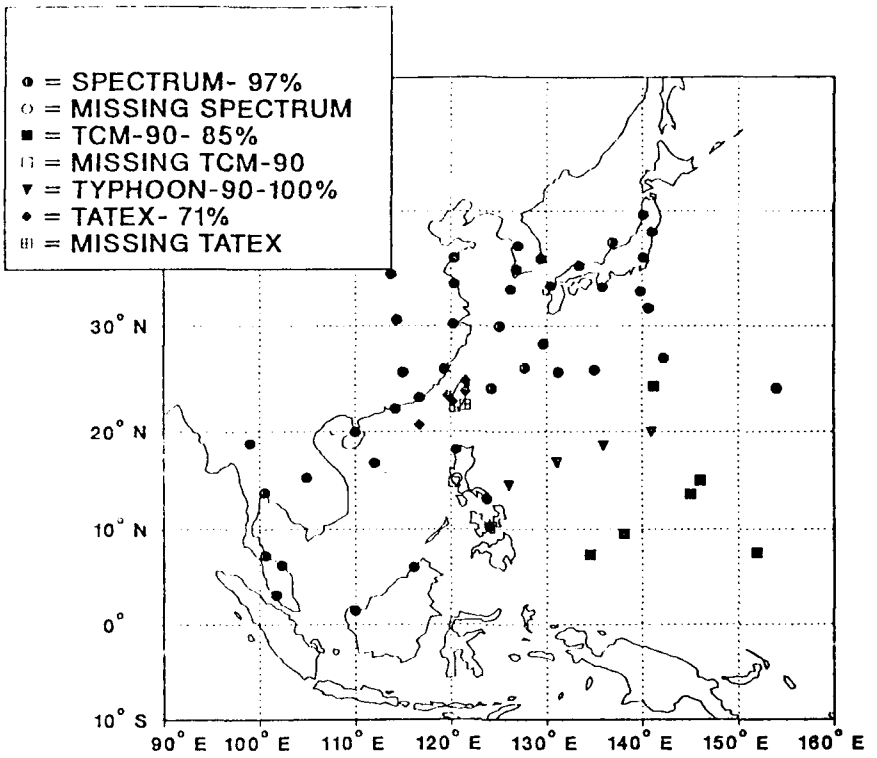


Figure 4.4 (continued)

90090700



90090706

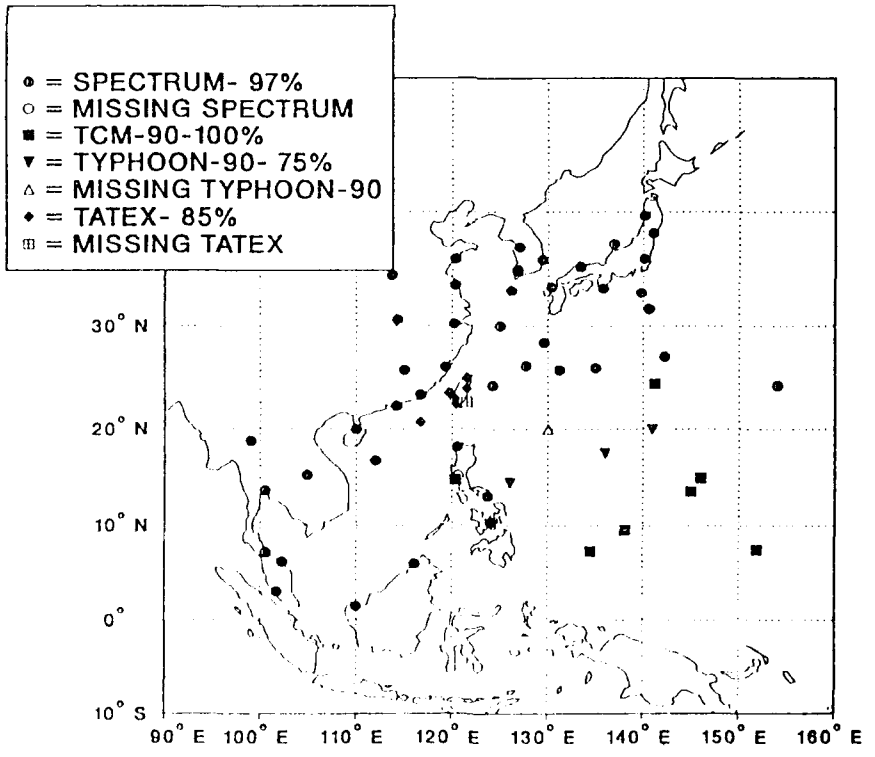
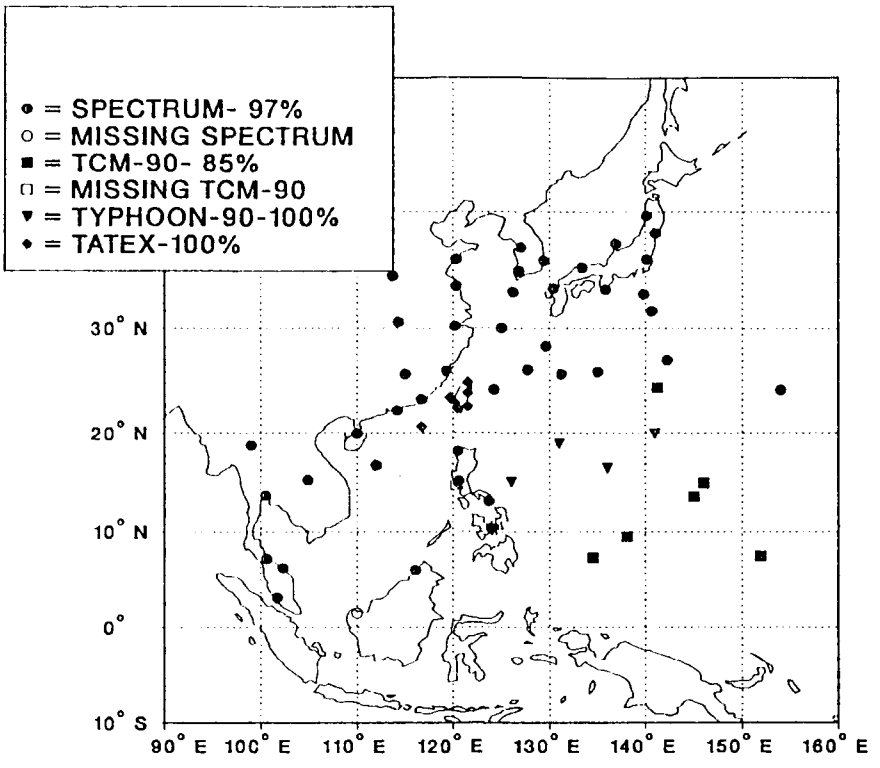


Figure 4.4 (continued)

90090712



90090718

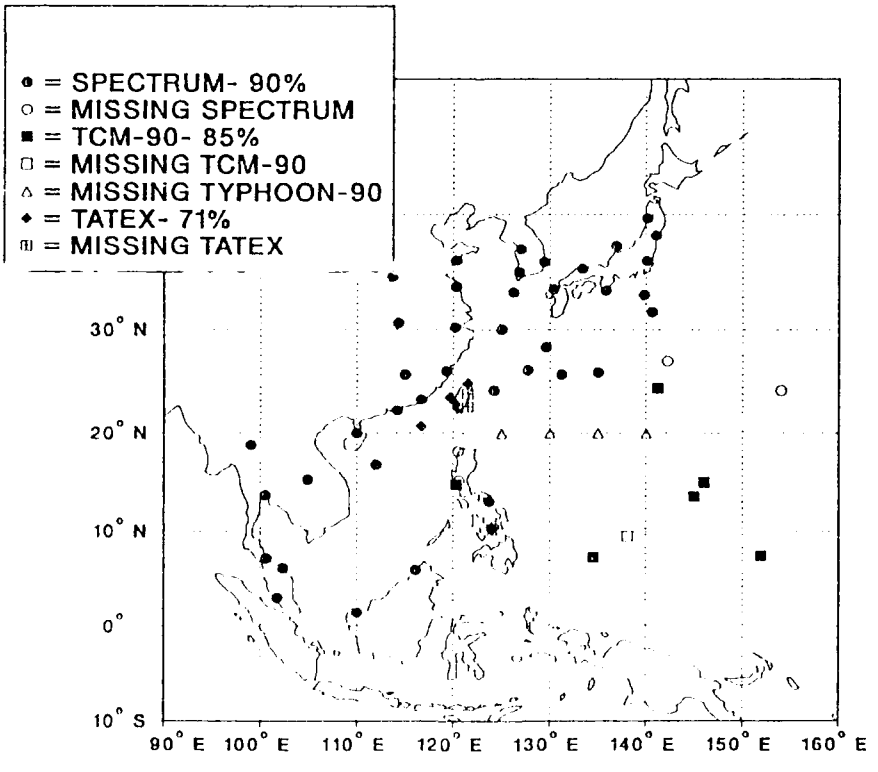


Figure 4.4 (continued)

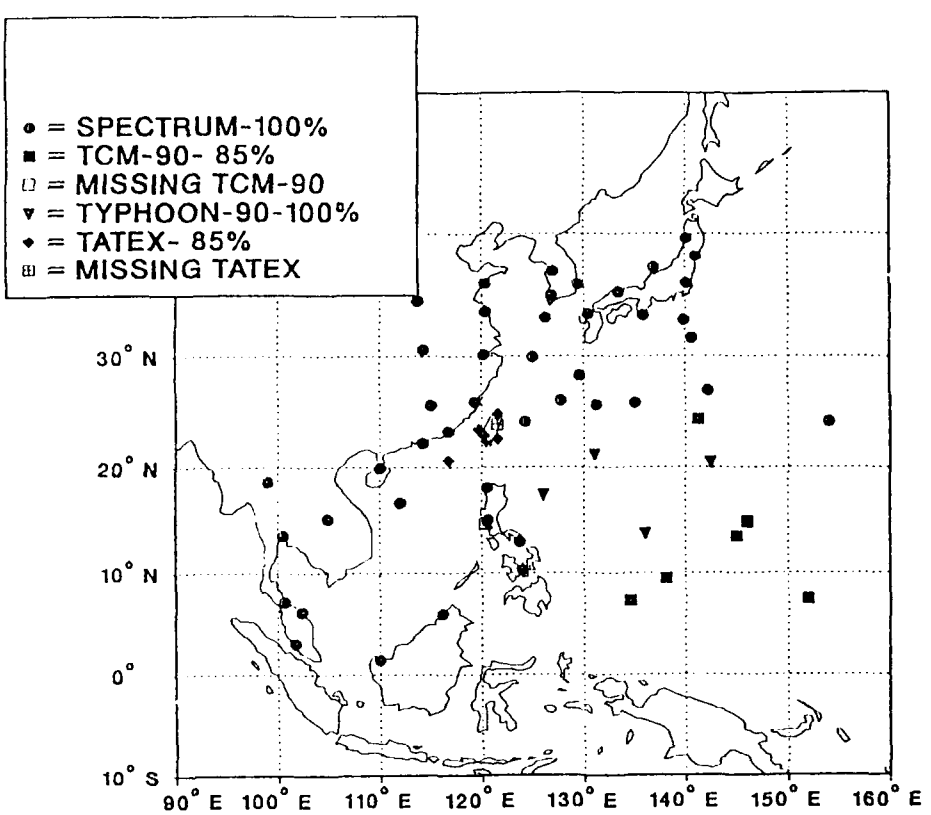


Figure 4.4 (continued)

4.5 IOP-5, Typhoon Ed

Communication failures caused the Pacific Island stations of Yap (91413) and Koror (91408) to miss all 06 and 18 UTC observations during this IOP.

No NOAA11 satellite imagery were received during this IOP due to ingestor problems at the University of Wisconsin. Attempts to retrieve the lost imagery are in progress.

Flight-level data from the DC-8 were collected on a mission centered on 06 UTC 13 September. Unfortunately, the aircraft was damaged on landing and no other flights could be scheduled during IOP-5.

Table 4.5.1 Satellite imagery summary for IOP-5

Date	Geostationary	Polar Orbiting
13 Sep	All GMS	None
14 Sep	All GMS	09,11 & 23 UTC NOAA10 passes 09 & 11 UTC DMSP8 passes

Table 4.5.2 Summary of reprocessed satellite cloud-tracked winds for IOP-5

Date	Number of vectors	Remarks
12 UTC 13 Sep	367	
18 UTC 13 Sep	374	
00 UTC 14 Sep	483	
06 UTC 14 Sep	118	Imagery not available - edited operational winds only
12 UTC 14 Sep	368	
18 UTC 14 Sep	493	

Table 4.5.3 Upper-air soundings during IOP-5

IOP-5, 90091300 - 90091412, TY ED

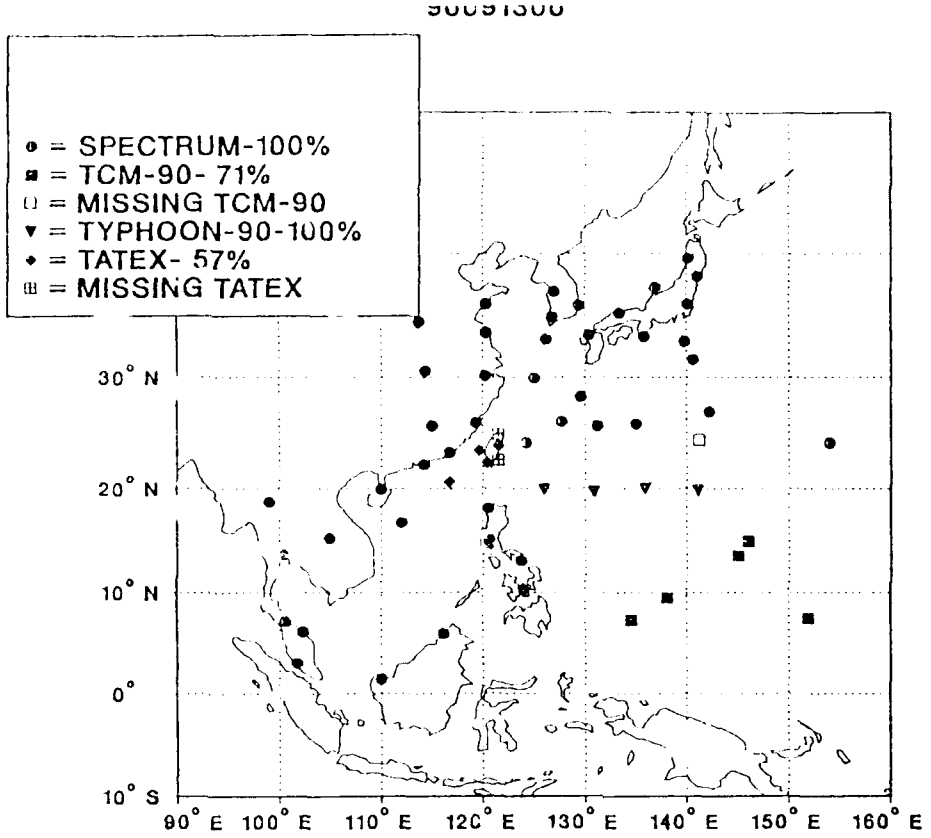
O = Real-time, # = Delayed data, X = Not Available

		0913				0914		
NO.	STATION	00	06	12	18	00	06	12
BLOCK 45 (HONG KONG)								
1	45004	O	O	O	O	O	O	O
BLOCK 47 (KOREA)								
2	47122	O	O	O	O	O	O	O
3	47138	O	O	O	O	O	O	O
4	47158	O	O	O	O	O	O	O
5	47185	O	O	O	O	O	O	O
BLOCK 47 (JAPAN)								
6	47582	O	O	O	O	O	O	O
7	47590	O	O	O	O	O	O	O
8	47600	O	O	O	O	O	O	O
9	47646	O	O	O	O	O	O	O
10	47678	O	O	O	O	O	O	O
11	47744	O	O	O	O	O	O	O
12	47778	O	O	O	O	O	O	O
13	47807	O	O	O	O	O	O	O
14	47827	O	O	O	O	O	O	O
15	47909	O	O	O	O	O	O	O
16	47918	O	O	O	O	O	O	O
17	47936	O	O	O	O	O	O	O
18	47945	O	O	O	O	O	O	O
19	47971	O	O	O	X	O	O	O
19	47991	O	O	O	X	O	O	O
BLOCKS 48,96 (THAILAND, MALAYSIA)								
21	48327	O	O	O	O	O	O	O
22	48407	O	O	O	O	O	O	O
23	48455	O	O	O	O	O	O	O
24	48568	O	O	O	O	O	O	O
25	48615	O	O	#	O	O	#	O
26	48648	O	O	O	O	O	#	O
27	96413	O	O	O	O	O	#	O
28	96471	O	O	O	O	O	#	O

Table 4.5.3 (continued)

IOP-5 (continued)

		0913				0914		
NO.	STATION	00	06	12	18	00	06	12
BLOCKS 54,57,58,59 (PEOPLES REPUBLIC OF CHINA)								
29	54857	O	O	O	O	O	#	O
30	57083	O	O	O	O	O	O	O
31	57494	O	O	O	O	O	#	O
32	57972	O	O	O	O	O	#	O
33	58150	O	O	O	O	O	O	O
34	58457	O	O	O	O	O	O	O
35	58847	O	O	O	O	O	O	O
36	59316	O	O	O	O	O	O	O
37	59758	O	O	O	O	O	O	O
38	59981	O	O	O	O	O	#	O
BLOCK 98 (PHILIPPINES)								
39	98223	O	X	O	X	O	X	X
40	98327	O	X	O	X	O	X	O
41	98426	X	#	X	O	#	O	X
42	98444	O	O	O	O	O	O	O
43	98646	O	X	O	O	O	O	#
BLOCK 91 (PACIFIC ISLANDS, NATIONAL WEATHER SERVICE)								
44	91217	O	O	O	O	O	O	O
45	91232	#	#	#	#	X	#	#
46	91334	O	X	O	O	O	O	O
47	91408	O	X	O	X	O	X	O
48	91413	O	X	O	X	O	X	O
BLOCK 47 (IWO JIMA)								
49	47000	X	X	X	X	X	X	X
BLOCK 46 (TAIWAN)								
50	46685	X	O	O	O	O	O	X
51	46699	O	X	O	X	O	X	O
52	46734	O	O	O	O	O	O	O
53	46747	O	X	O	X	O	X	O
54	MOTOI	X	X	X	X	X	X	X
55	46780	X	#	#	X	X	X	X
56	46810	O	X	X	X	O	X	X
SHIPS								
1	EREH	O	O	O	O	X	O	O
2	EREI	O	O	O	O	O	O	O
3	UHQS	O	O	O	O	O	O	O
4	UMAY	O	O	O	O	O	O	O
5	JBOA	O	O	O	O	O	O	O
6	ICCX	O	O	O	X	O	O	O



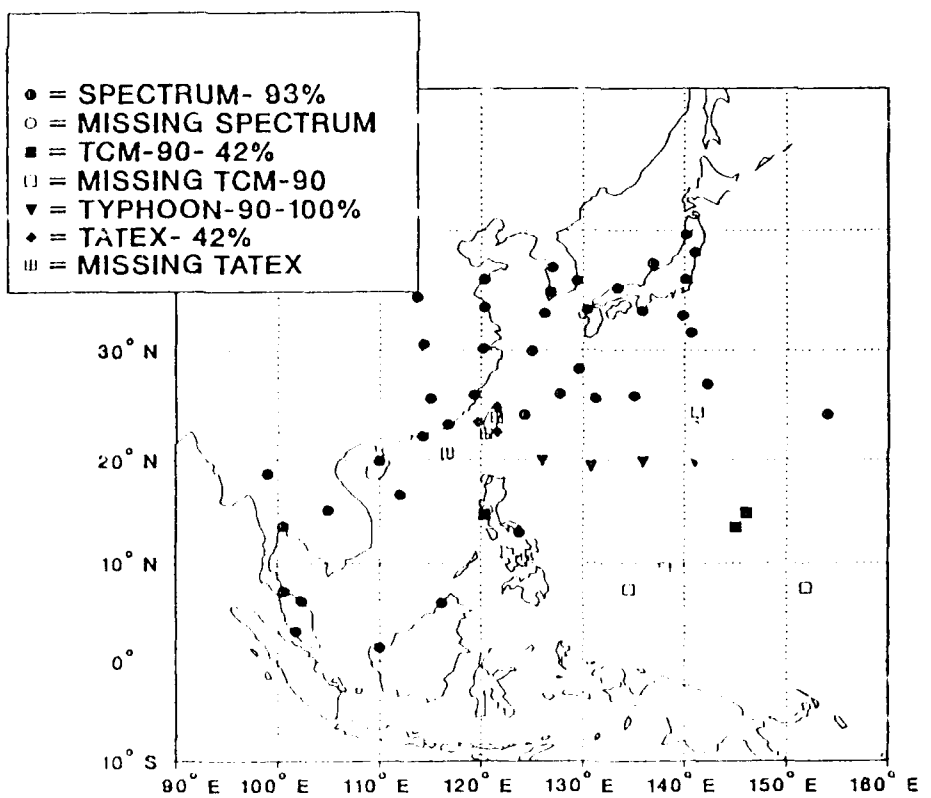
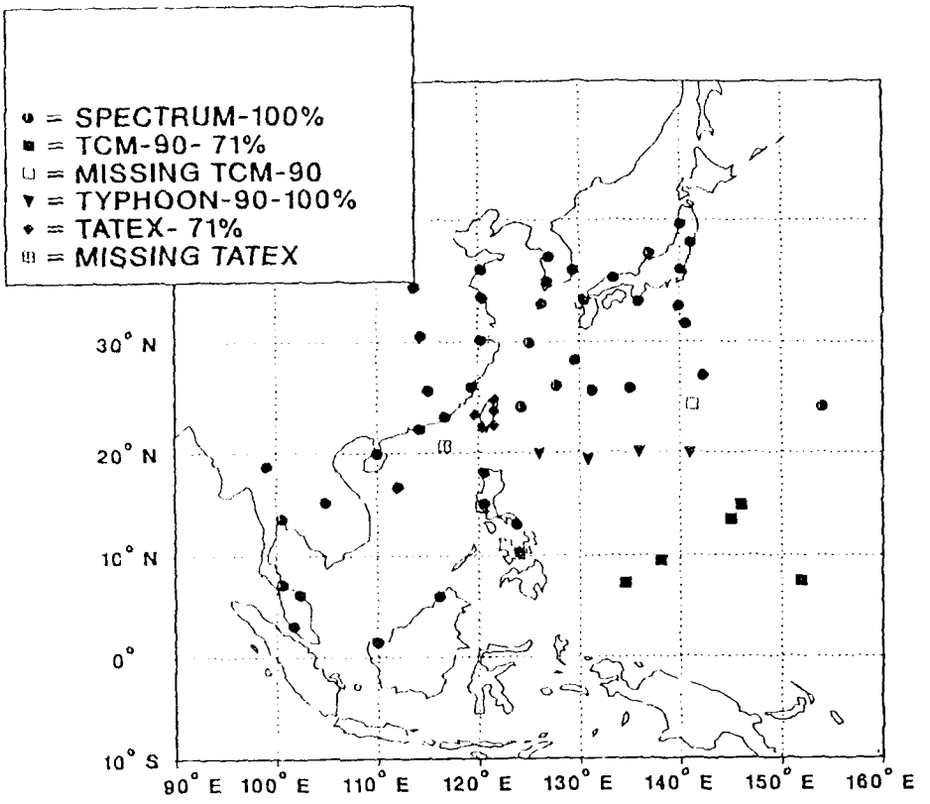


Figure 4.5 Spatial coverage of upper-air soundings during IOP-5

90091312



90091318

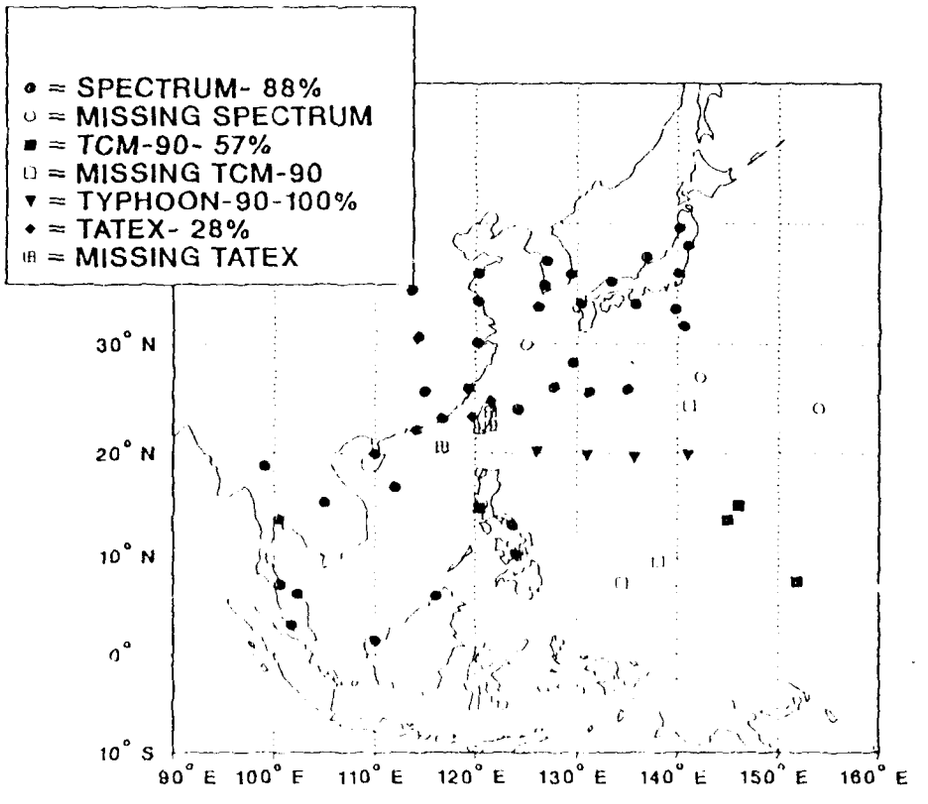
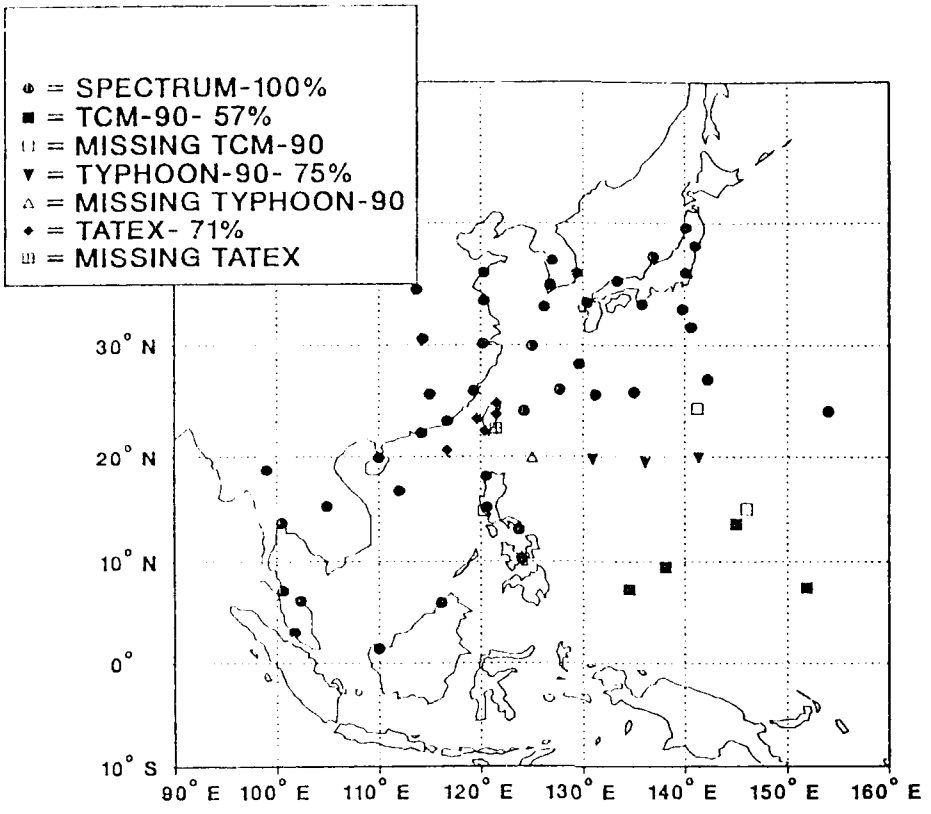


Figure 4.5 (continued)

90091400



90091406

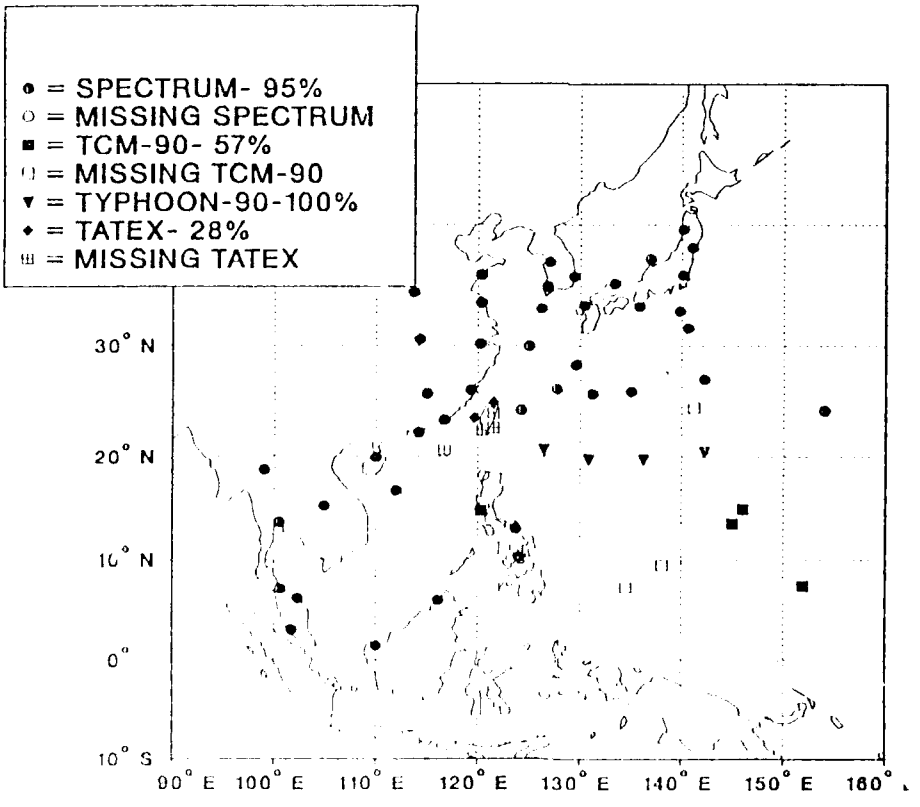


Figure 4.5 (continued)

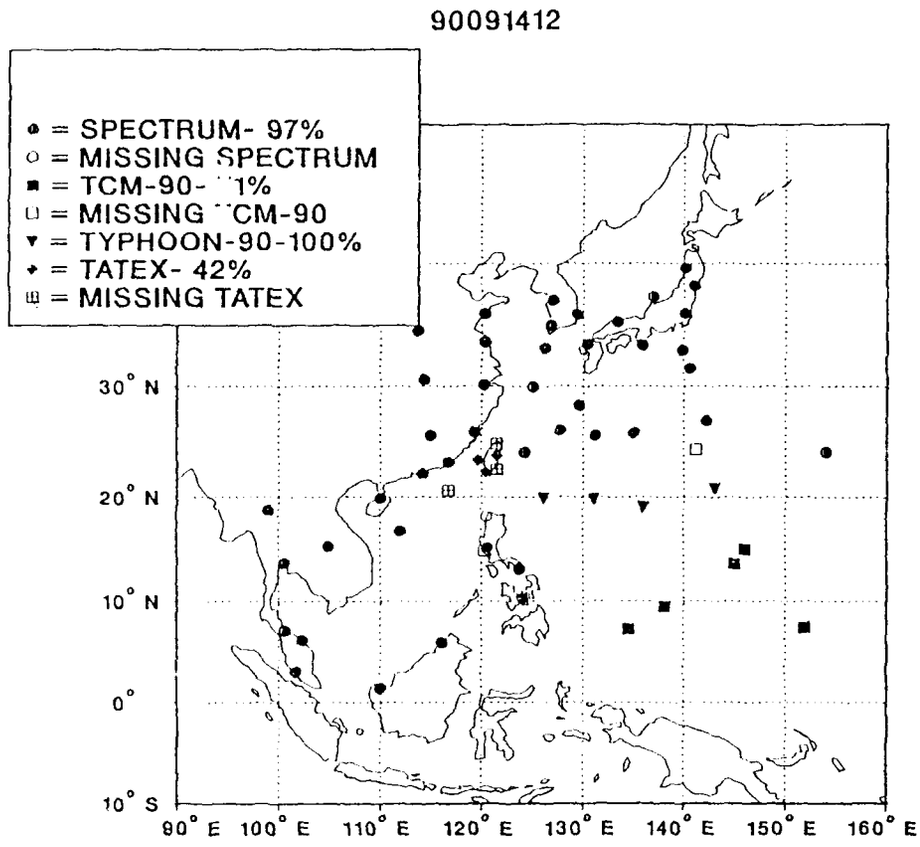


Figure 4.5 (continued)

4.6 IOP-6, Typhoon Ed/Supertyphoon Flo

No NOAA11 imagery were collected during IOP-6.

A DC-8 flight centered on 06 UTC 16 September was made into Supertyphoon Flo. Both dropwindsonde and flight-level data were collected on this flight.

Table 4.6.1 Satellite imagery summary for IOP-6

Date	Geostationary	Polar orbiting
15 Sep	All GMS	11 UTC NOAA10 pass
16 Sep	All GMS	10,12 & 23 UTC NOAA passes 10 & 22 UTC DMSP8 passes

Table 4.6.2 Dropwindsonde data summary for IOP-6

Date (MDDHHMM)	Initial press[1]	Dual temp[2]	Final press	Final temp	Final altitude	Percent winds
9160531	1	1	1005.2	26.2	-69.4	30
9169542	0	1	1027.5	26.4		90
9160553	0	1	1034.7	24.1		50
9160606	0	0	689.4	13.2	ET[3]	0
9160616	1	1	995.0	25.2	-82.1	60
9160627	1	0	1006.1	25.9	-98.8	90
9160640	1	1	995.2	27.9	-23.0	60
9160651	0	1	996.9	26.7	-69.3	0
9160701	1	1	987.8	28.0	-8.3	20
9160722	1	0	858.4	24.2	ET[3]	0
9160740	0	0	988.4	25.6	-4.9	40
9160750	1	1	987.2	26.7	45.4	20
9160818	1	0	1005.1	26.6	-83.9	30
9160826	1	0	1002.8	27.5	-69.3	90
9160840	1	1	1013.0	28.0	-162.5	100
9160850	1	1	1006.6	28.5	-82.0	60
9160901	1	1	1009.3	28.0	-104.4	70
9160913	1	1	1011.0	27.7	-83.6	90
9160923	0	1	1017.1	27.5	-114.5	70
9160944	1	1	1020.4	27.4	-123.9	60
9160957	1	1	(1067)	28.2		80
9161006	1	0	(1039)	29.1		100
9161019	1	0	1020.0	28.7	-116.3	80

[1] '0' indicates that the initial pressure is correct from launch
'1' indicates that the pressure from the first few seconds after launch is below calibrated range.

[2] '0' indicates that there were no dual temperatures.
'1' indicates that there were dual temperatures.

[3] Early termination

Table 4.6.3 Reprocessed satellite cloud-tracked winds summary for IOP-6

Date	Number of vectors	Remarks
00 UTC 15 Sep	626	
06 UTC 15 Sep	682	
12 UTC 15 Sep	548	
18 UTC 15 Sep	563	
00 UTC 16 Sep	582	
06 UTC 16 Sep	533	No operational winds available - reprocessed winds are assigned the time 9009160423
12 UTC 16 Sep	562	
18 UTC 16 Sep	503	

Table 4.6.4 Upper-air soundings during IOP-6

IOP-6, 90091500 - 90091612, TY ED, STY FLO

O = Real-time, # = Delayed data, X = Not available

		0915				0916		
NO.	STATION	00	06	12	18	00	06	12
BLOCK 45 (HONG KONG)								
1	45004	O	O	O	O	O	O	O
BLOCK 47 (KOREA)								
2	47122	O	O	O	O	O	O	O
3	47138	O	O	O	O	O	O	O
4	47158	O	O	O	O	O	O	O
5	47185	O	O	O	O	O	O	O
BLOCK 47 (JAPAN)								
6	47582	O	O	O	O	O	O	O
7	47590	O	O	O	O	O	O	O
8	47600	O	O	O	O	O	O	O
9	47646	O	O	O	O	O	O	O
10	47678	O	O	O	O	O	O	O
11	47744	O	O	O	O	O	O	O
12	47778	O	O	O	O	O	O	O
13	47807	O	O	O	O	O	O	O
14	47827	O	O	O	O	O	O	O
15	47909	O	O	O	O	O	O	O
16	47918	O	O	O	O	O	O	O
17	47936	O	O	O	O	O	O	O
18	47945	O	O	O	O	O	O	O
19	47971	O	X	O	X	O	O	O
20	47991	O	X	O	X	O	O	#
BLOCKS 48,96 (THAILAND, MALAYSIA)								
21	48327	O	O	O	O	O	O	O
22	48407	O	O	O	O	O	O	O
23	48455	O	O	O	O	O	O	O
24	48568	O	X	O	X	O	X	O
25	48615	O	O	O	X	O	O	X
26	48648	#	#	O	O	O	#	O
27	96413	O	#	X	O	O	O	O
28	96471	O	O	O	#	O	O	O

Table 4.6.4 (continued)

IOP-6 (continued)

		0915				0916		
NO.	STATION	00	06	12	18	00	06	12
BLOCKS 54,57,58,59 (PEOPLES REPUBLIC OF CHINA)								
29	54857	O	O	O	O	O	O	O
30	57083	O	O	O	#	O	O	O
31	57494	O	O	O	#	O	O	O
32	57972	O	O	O	#	O	O	O
33	58150	O	O	O	O	O	O	O
34	58457	O	O	O	O	O	O	O
35	58847	O	O	O	O	O	O	O
36	59316	O	O	O	O	O	O	O
37	59758	O	O	O	O	O	O	O
38	59981	O	O	O	#	O	#	O
BLOCK 98 (PHILIPPINES)								
39	98223	X	X	O	X	X	X	X
40	98327	O	X	O	X	O	X	O
41	98426	X	O	X	O	X	O	X
42	98444	O	O	O	O	O	O	O
43	98646	O	O	O	O	O	O	O
BLOCK 91 (PACIFIC ISLANDS, NATIONAL WEATHER SERVICE)								
44	91217	O	O	O	O	O	O	O
45	91232	O	O	O	O	O	O	O
46	91334	O	X	O	O	O	O	O
47	91408	O	X	O	O	O	O	O
48	91413	O	X	O	X	O	O	O
BLOCK 47 (IWO JIMA)								
49	47000	X	X	X	X	X	X	X
BLOCK 46 (TAIWAN)								
50	46685	X	O	O	O	O	O	X
51	46699	O	X	O	X	O	X	O
52	46734	O	O	O	O	O	O	O
53	46747	O	X	O	X	O	X	O
54	MOTOI	X	X	X	X	X	X	X
55	46780	X	X	X	X	X	X	X
56	46810	X	O	X	X	O	X	X
SHIPS								
1	FRFH	O	O	O	O	O	O	O
2	FRFI	O	O	O	O	O	O	O
3	UHQS	O	#	O	O	O	O	O
4	UMAY	O	#	O	O	O	O	O
5	JBOA	O	O	O	O	O	X	X
6	KCCX	O	O	O	X	X	X	X

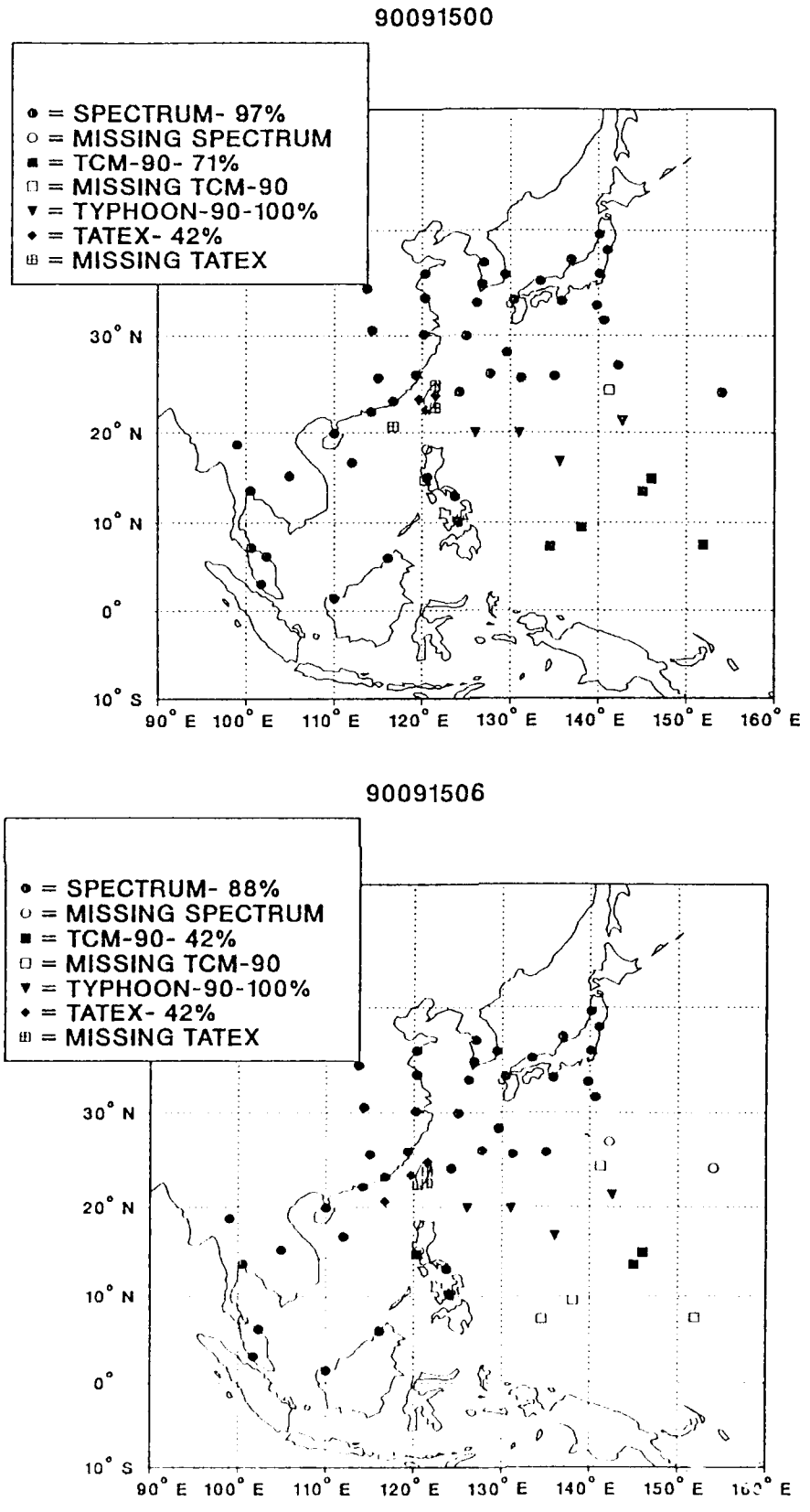
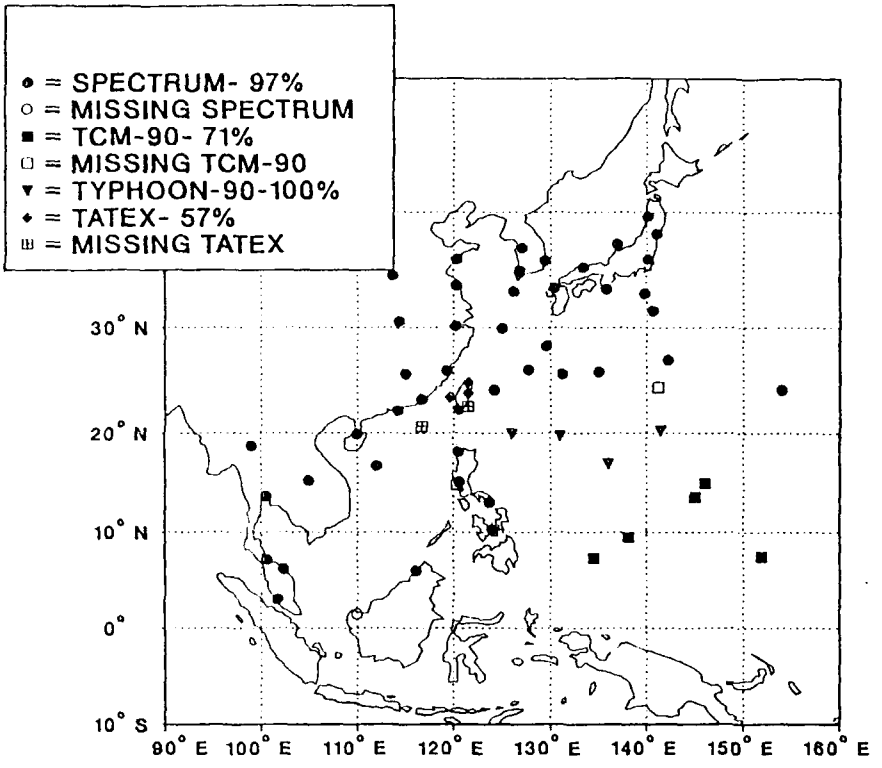


Figure 4.6 Spatial coverage of upper-air soundings during IOP-6

90091512



90091518

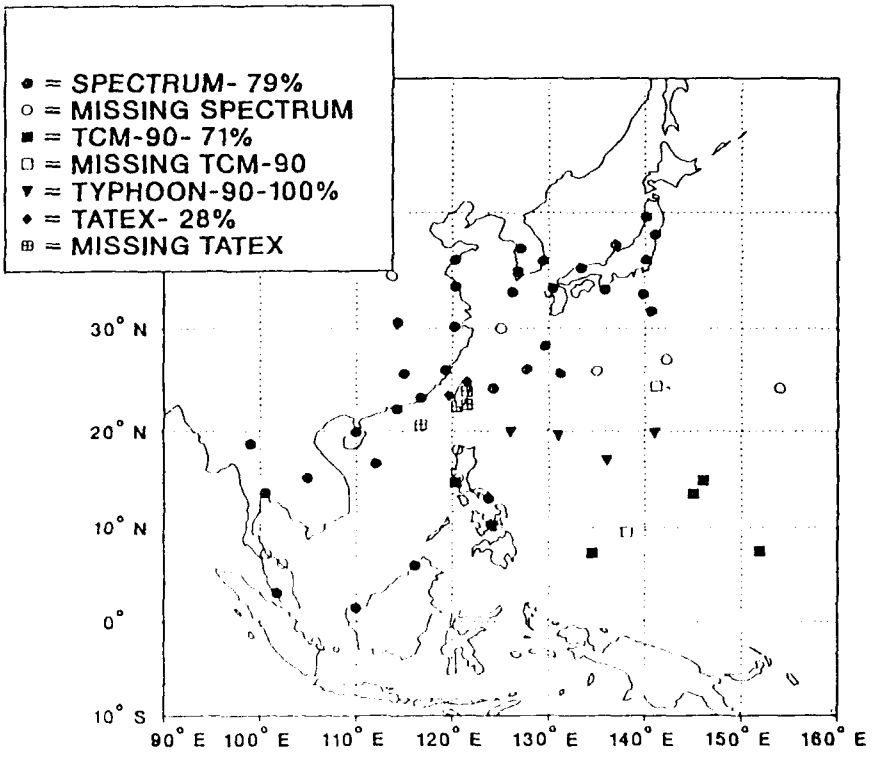
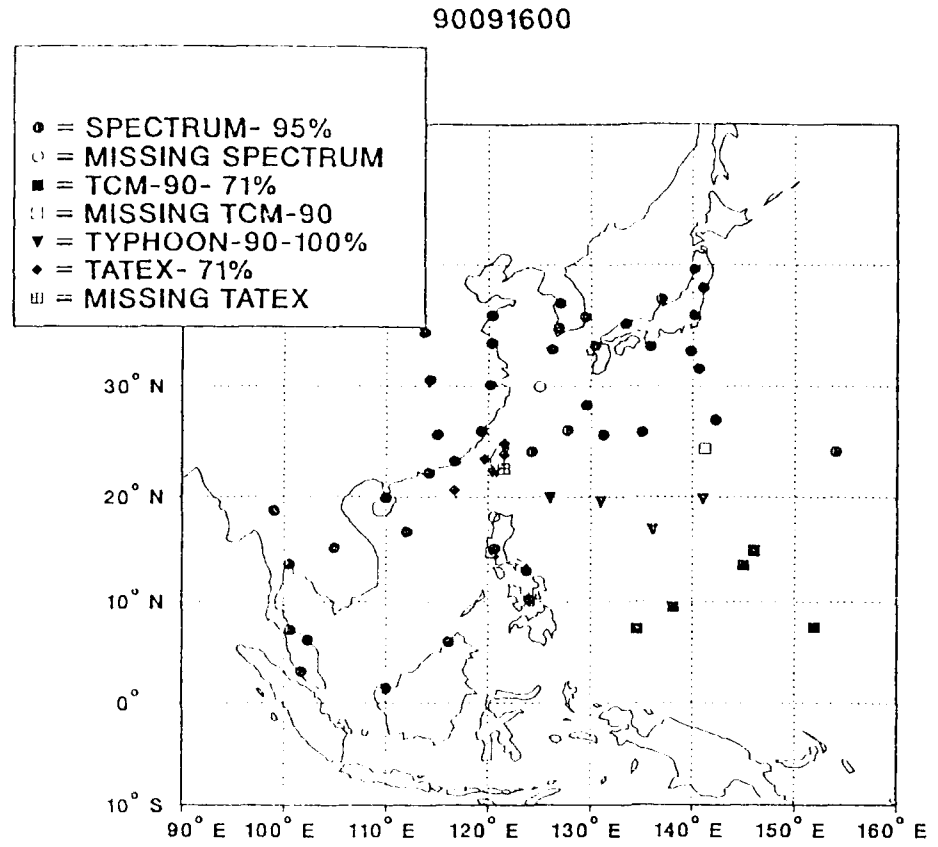


Figure 4.6 (continued)



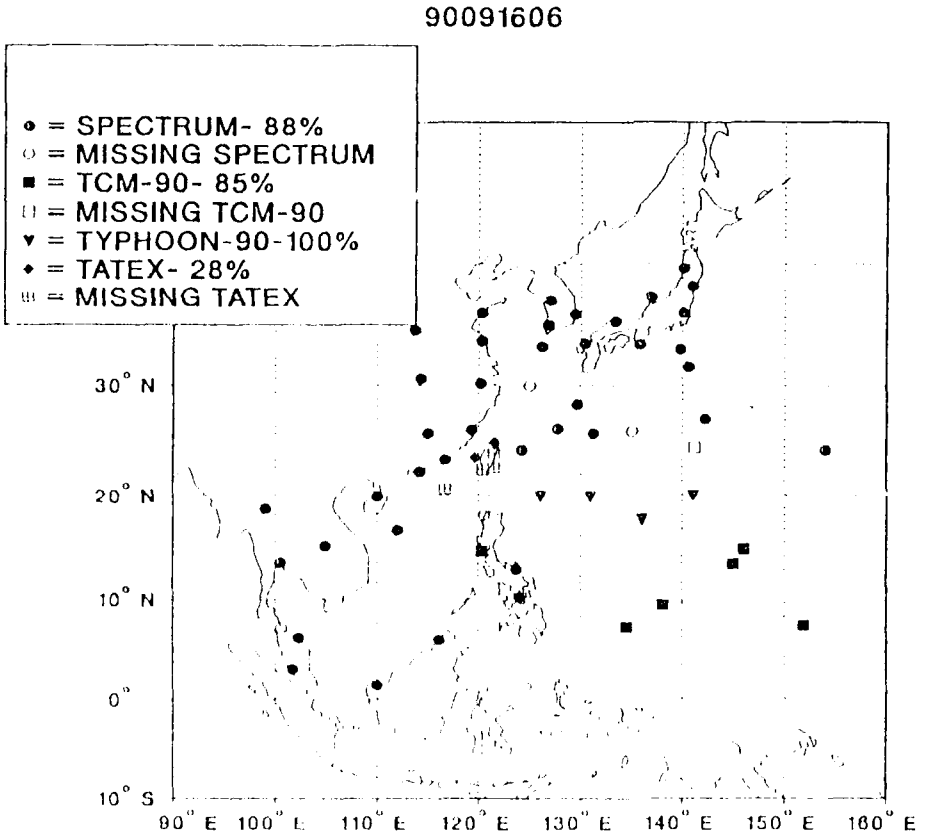


Figure 4.6 (continued)

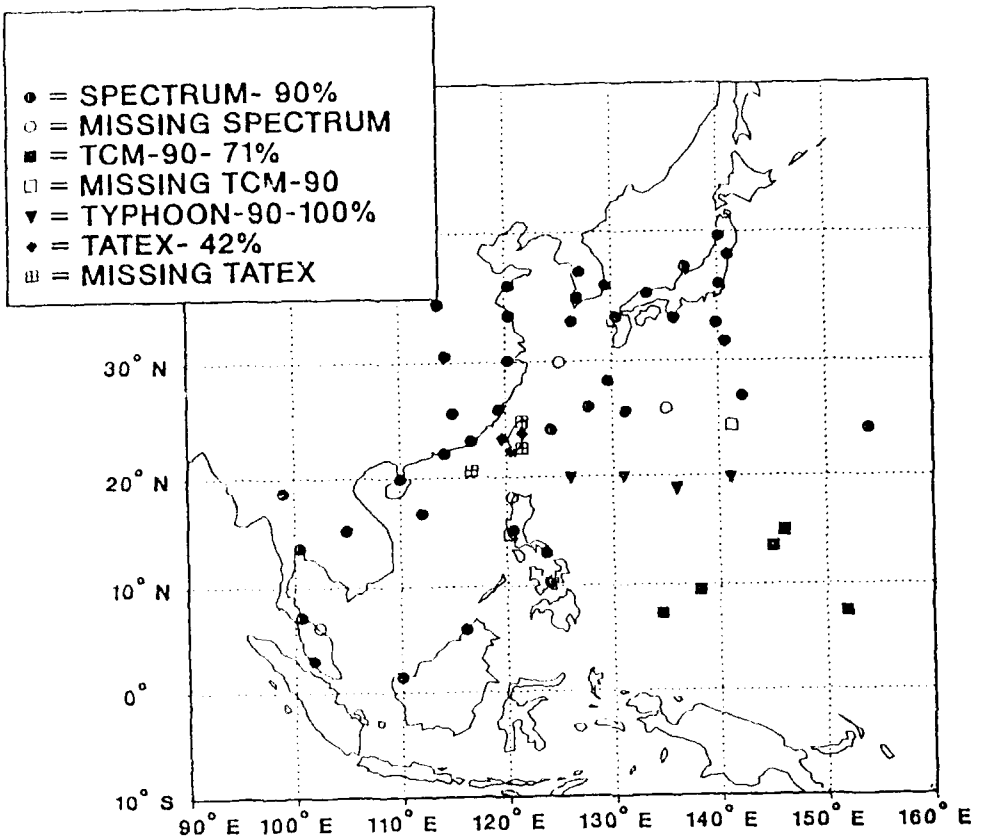


Figure 4.6 (continued)

4.7 IOP-7, Supertyphoon Flo

No 06 and 18 UTC observations from SPECTRUM stations are available after 00 UTC 18 September since the SPECTRUM IOP began on 00 UTC 15 September and ended on 00 UTC 18 September. Exceptions were southern Japanese stations that were being threatened by Supertyphoon Flo. The Japanese ships JCCX and JBOA departed at the end of their scheduled deployment on 00 17 September.

Two DC-8 missions were centered on 07 UTC 17 September and 06 UTC 18 September. Both flight-level and dropwindsonde data were collected on these flights.

Table 4.7.1 Satellite imagery summary for IOP-7

Date	Geostationary	Polar orbiting
17 Sep	All GMS	10 & 22 UTC NOAA10 passes 10 & 21 UTC DMSP8 passes
18 Sep	All GMS	06 & 18 UTC NOAA passes 10 UTC DMSP8 passes

Table 4.7.2 Dropwindsonde data summary for IOP-7

Date (MDDHHMM)	Initial press[1]	Dual temp[2]	Final press	Final temp	Final altitude	Percent winds
9170225	0	1	1011.5	28.8	-63.2	80
9170235	0	0	259.55	-39.7	ET[3]	0
9170240	1	0	1013.4	27.0		50
9170247	1	0	970.5	28.2	ET[3]	80
9170300	1	0	307.0	-28.3	ET[3]	
9170311	1	0	1013.7	28.0	-75.1	80
9170319	0	1	1010.0	27.5	-25.5	80
9170353	0	1	1013.7	28.0	-93.5	90
9170403	1	0	1004.1	29.2	-59.0	100
9170421	1	1	1004.7	27.5	-102.1	70
9170435	1	1	964.5	25.8	ET[3]	90
9170452	1	0	891.8	27.4	ET[3]	60
9170500	1	1	981.6	27.4	-62.4	10
9170543	1	1	737.7	15.0	ET[3]	50
9170605	1	1	1002.9	29.6	-80.55	80
9170614	1	0	1000.9	29.2	-31.5	80
9170635	1	1	1002.3	28.4	-65.0	10
9170640	1	0	1011.7	28.2	-127.1	100
9170704	1	0	1011.2	28.4	-90.8	100
9170714	1	1	1014.4	28.0	-110.1	90
9170735	1	0	1007.3	28.0	-73.8	50
9170746	1	1	1013.4	27.5	-89.4	20
9170800	1	0	1012.7	28.2	-82.7	60

Table 4.7.2 (continued)

Date (MDDHHMM)	Initial press[1]	Dual temp[2]	Final press	Final temp	Final altitude	Percent winds
9170811	1	0	1008.0	27.9	-50.6	80
9170825	1	1	1012.8	28.27	-93.9	0
9170835	1	0	1012.0	39.5		80
9170845	0	0	934.1	23.1	ET[3]	0
91805	1	1	1020.5	28.0	-148 0	100
9180520	1	0	1018.9	29.2	-118.8	90
9180540	1	0	1025.6	29.8	-169.0	80
9180549	1	0	428.6	-14.3	ET[3]	0
9180557	1	0	1009.5	28.0	-48.1	90
9180607	1	0	1019.6	29.2	-112.8	60
9180619	1	1	927.9	22.6	ET[3]	80
9180631	1	0	910.8	20.7	ET[3]	90
9189640	1	0	1023.8	27.4	-162.0	70
9180656	1	0	452.0	-8.7	ET[3]	10
9180703	1	1	1014.7	27.9	-118.9	90
9180714	1	0	973.69	25.9	ET[3]	90
9180725	0	1	1006.1	25.9	-22.4	90
9180736	1	0	1001.7	28.5	-7.7	60
9180747	1	0	1024.4	27.5	-179.4	0
9180758	1	1	985.5	27.9	ET[3]	20
9180808	1	0	1014.0	28.4	-111.8	50
9180821	1	1	1004.8	27.9	-86.3	100
9180831	1	1	926.0	27.4	ET[3]	0
9180854	1	1	699.1	14.4	ET[3]	50
9180915	1	1	891.5	17.0		60
9180922	1	1	938.3	26.1	ET[3]	50

Table 4.7.2 (continued)

Date (MDDHHMM)	Initial press[1]	Dual temp[2]	Final press	Final temp	Final altitude	Percent winds
9180939	1	0	649.30	11.8	ET[3]	20
9180951	1	1	991.28	(30.9)		30
9181003	0	0	997.10	24.9	-91.2	100
9181016	1	0	(1044)	26.4	-476.2	70

[1] '0' indicates that the initial pressure is correct from launch
'1' indicates that the pressure from the first few seconds after launch is below calibrated range.

[2] '0' indicates that there were no dual temperatures.
'1' indicates that there were dual temperatures.

[3] Early termination

Table 4.7.3 Reprocessed satellite cloud-tracked winds summary for IOP-6

Date	Number of vectors	Remarks
00 UTC 17 Sep	649	
06 UTC 17 Sep	501	
12 UTC 17 Sep	738	
18 UTC 17 Sep	633	
00 UTC 18 Sep	670	
06 UTC 18 Sep	760	
12 UTC 18 Sep	525	
18 UTC 18 Sep	271	
00 UTC 19 Sep	389	

Table 4.7.4 Upper-air soundings during IOP-7

IOP-7, 90091700 - 90091900, TY ED, STY FLO

O = Real-time, O + h = h hours after time, # = Delayed data, X = Not Available

		0917				0918				0919
NO.	STATION	00	06	12	18	00	06	12	18	00
BLOCK 45 (HONG KONG)										
1	45004	O	O	O	O	O	X	O	X	O
BLOCK 47 (KOREA)										
2	47122	O	O	O	O	O	O	O	O	O
3	47138	O	O	O	O	O	X	O	X	O
4	47158	O	O	O	O	O	X	O	X	O
5	47185	O	O	O	O	O	X	O	X	O
BLOCK 47 (JAPAN)										
6	47582	O	O	O	O	O	X	O	X	O
7	47590	O	O	O	O	O	X	O	X	O
8	47600	O	O	O	O	O	O	O	O	O
9	47646	O	O	O	O	O	O	O	O	O
10	47678	O	O	O	O	O	O	O	O	O
11	47744	O	O	O	O	O	O	O	O	O
12	47778	O	O	O	O	O	O	O	O	O
13	47807	O	O	O	O	O	O	O	O	O
14	47827	O	O	O	O	O	O	O	O	O
15	47909	O	O	O	O	O	O	O	X	O
16	47918	O	O	O	O	O	X	O	X	O
17	47936	O	X	O	O	O	X	O	X	O
18	47945	O	O	O	O	O	X	O	X	O
19	47971	O	O	O	X	O	X	O	X	O
20	47991	O	O	O	X	O	X	O	X	O
BLOCKS 48,96 (THAILAND, MALAYSIA)										
21	48327	O	O	O	O	O	X	O	X	O
22	48407	O	O	O	O	O	X	O	X	O
23	48455	O	O	O	O	O	X	O	X	O
24	48568	O	O	O	O	O	X	O	X	O
25	48615	O	#	O	O	O	X	X	X	O
26	48648	O	#	O	O	O	X	X	X	O
27	96413	O	#	O	O	O	X	X	X	O
28	96471	O	#	O	O	O	X	O	X	O

IOP-7 (continued)

		0917				0918				0919
NO.	STATION	00	06	12	18	00	06	12	18	00
BLOCKS 54,57,58,59 (PEOPLES REPUBLIC OF CHINA)										
29	54857	O	O	O	O	O	X	O	X	O
30	57083	O	O	O	O	O	X	O	O	O
31	57494	O	O	O	O	O	X	O	O	O
32	57972	O	O	O	O	O	X	O	X	O
33	58150	O	O	O	O	O	O	O	O	O
34	58457	O	O	O	O	O	X	O	X	O
35	58847	#	O	O	O	O	X	O	X	O
36	59316	O	O	O	O	O	X	O	X	O
37	59758	O	O	O	O	O	X	O	X	O
38	59981	X	X	X	X	X	X	X	O	O
BLOCK 98 (PHILIPPINES)										
39	98223	X	X	X	X	O	X	X	X	X
40	98327	O	X	O	X	O	X	X	X	O
41	98426	X	#	X	O	X	O	X	O	X
42	98444	O	O	O	O	O	X	O	X	O
43	98646	O	O	O	O	X	X	X	X	X
BLOCK 91 (PACIFIC ISLANDS, NATIONAL WEATHER SERVICE)										
44	91217	O	O	O	O	O	O	O	O	O
45	91232	O	O	O	X	O	X	O	X	O
46	91334	O	O	O	O	O	O	O	O	O
47	91408	O	X	O	O	O	O	O	O	O
48	91413	O	O	O	O	O	O	O	O	O
BLOCK 47 (IWO JIMA)										
49	47000	X	X	X	X	X	X	X	X	#
BLOCK 46 (TAIWAN)										
50	46685	X	O	O	O	O	O	O	O	X
51	46699	X	X	O	X	O	X	O	X	O
52	46734	O	O	O	X	O	O	O	O	O
53	46747	O	X	X	X	X	X	X	X	X
54	MOTOI	X	X	X	X	X	X	X	X	X
55	46780	X	#	#	#	#	X	#	X	X
56	46810	O	X	X	X	X	O	X	X	X
SHIPS										
1	ERFH	O	O	O	O	O	O	O	O	O
2	ERFI	O	O	O	O	O	O+1	O	O	O
3	UHQS	O	X	O	X	O	#	O	#	O
4	UMAY	O	O	#	O	O	O	O	O	O
5	JBOA	X	X	X	X	X	X	X	X	X
6	KCCX	X	X	X	X	X	X	X	X	X

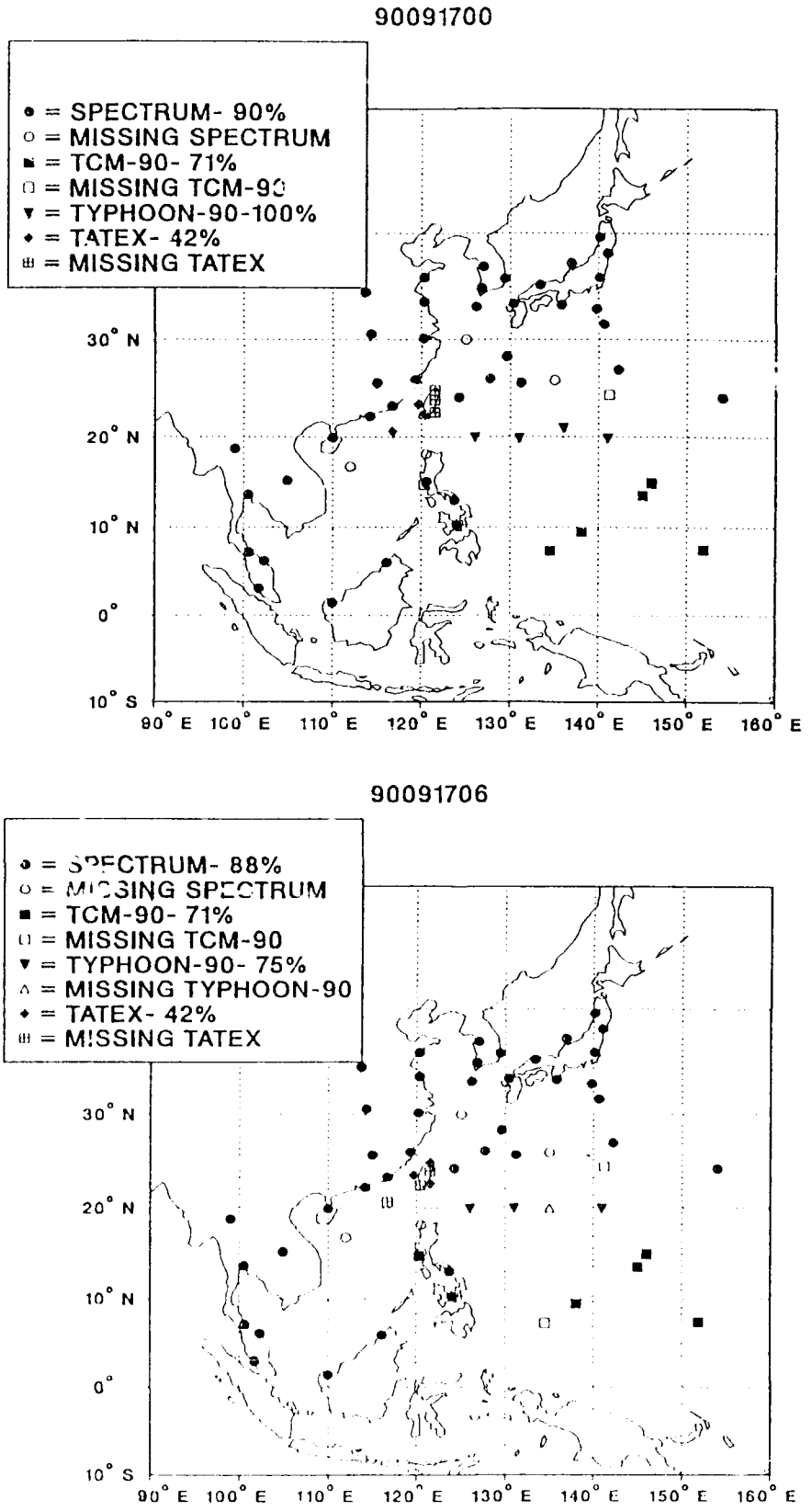
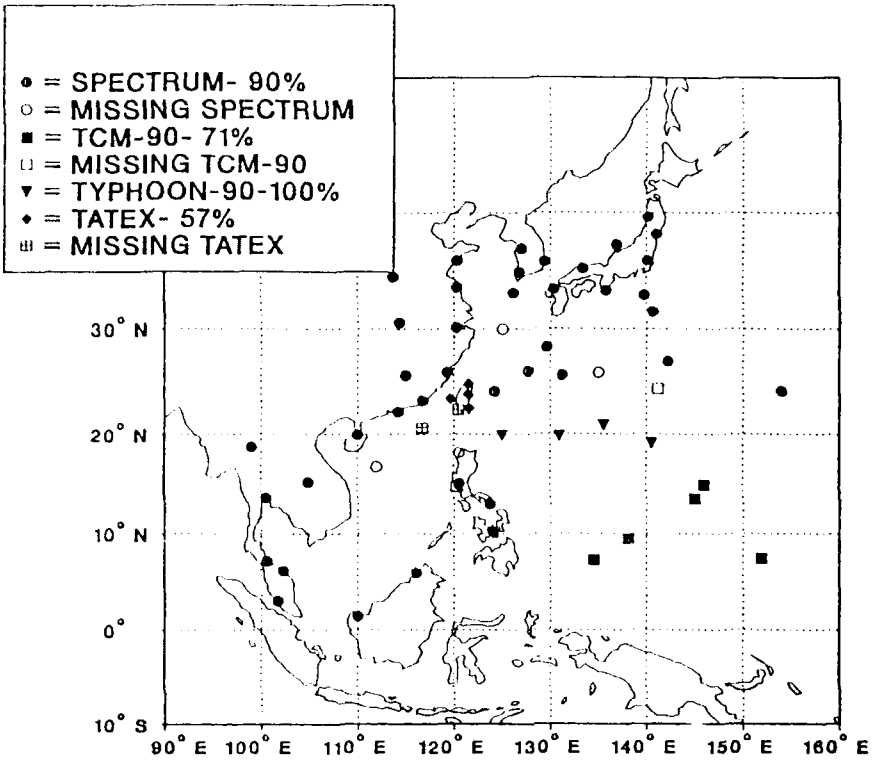


Figure 4.7 Spatial coverage of upper-air soundings during IOP-7

90091712



90091718

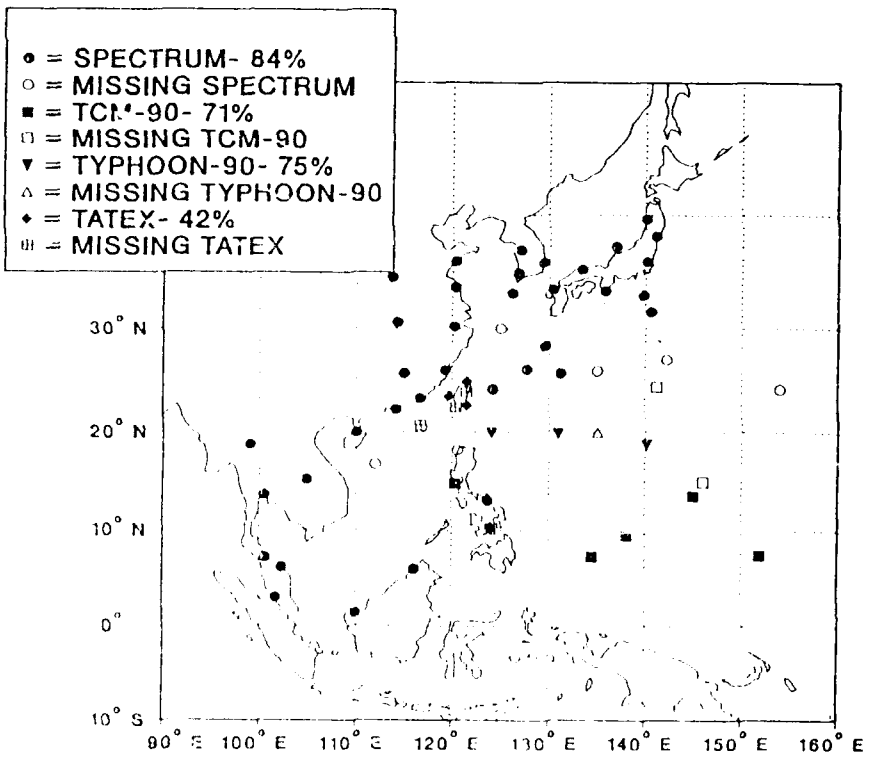
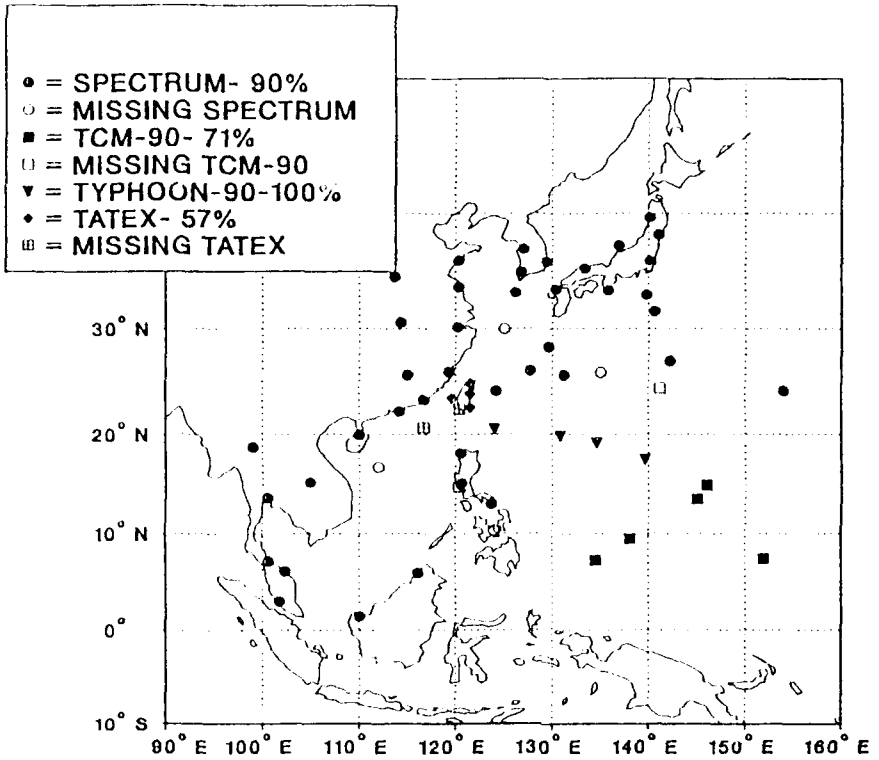


Figure 4.7 (continued)

90091800



90091806

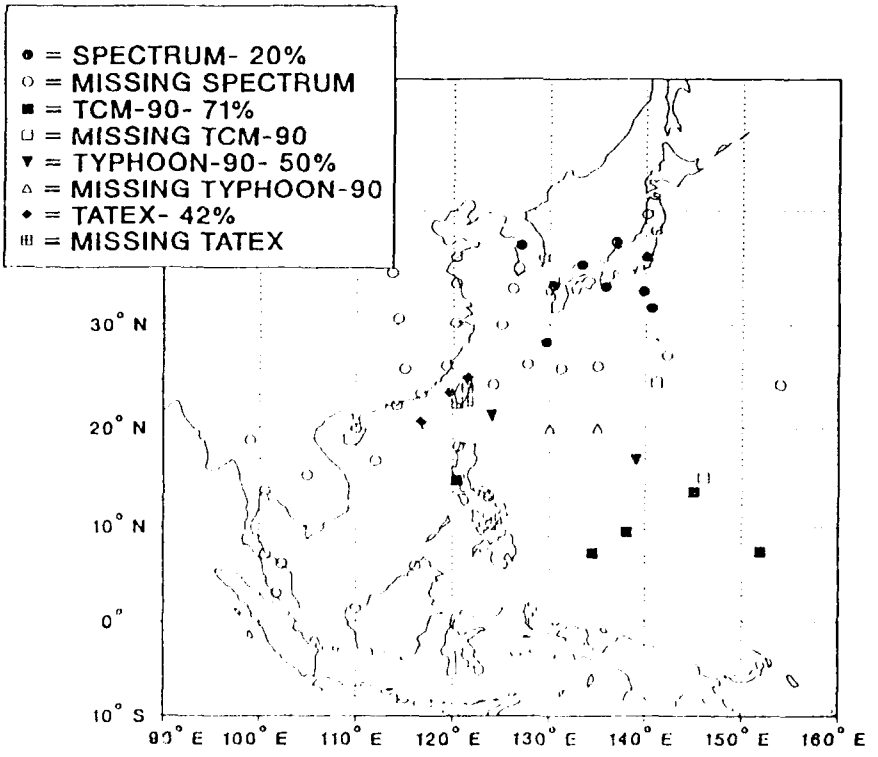
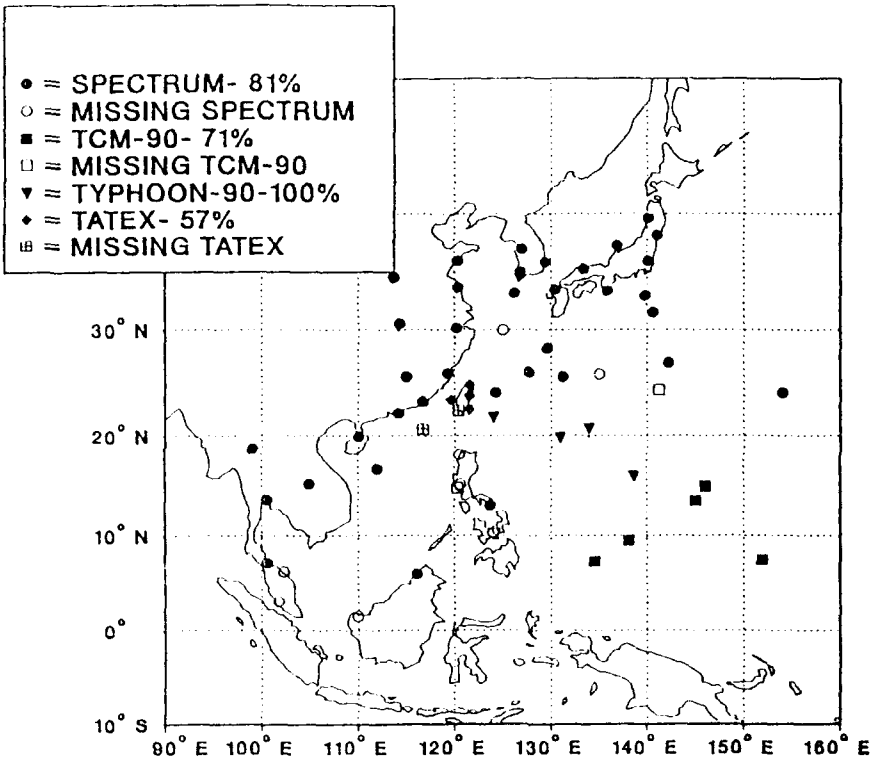


Figure 4.7 (continued)

90091812



90091818

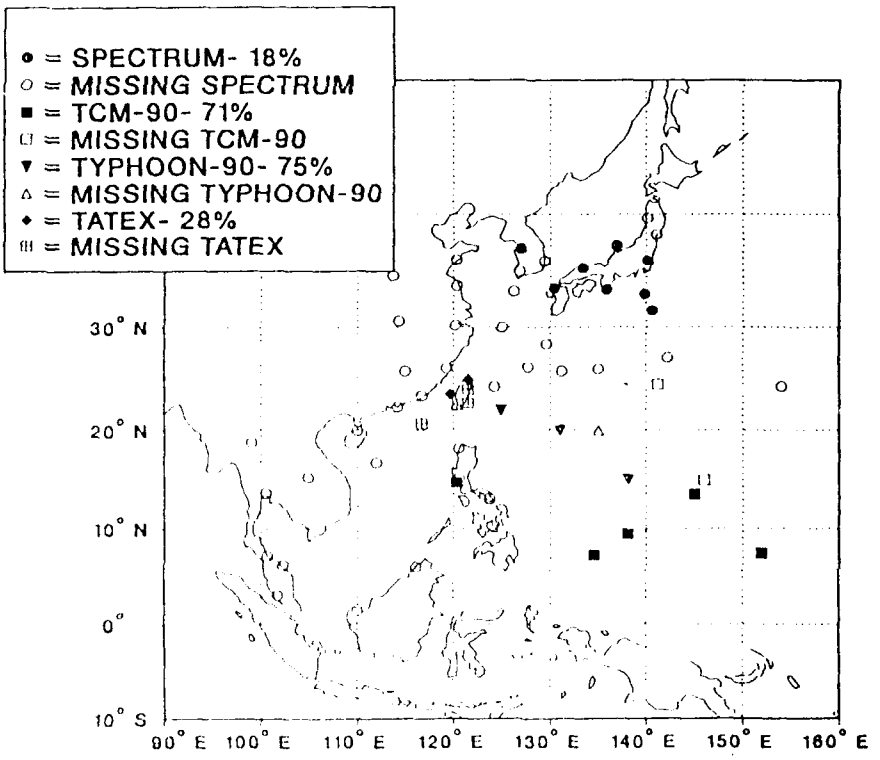


Figure 4.7 (continued)

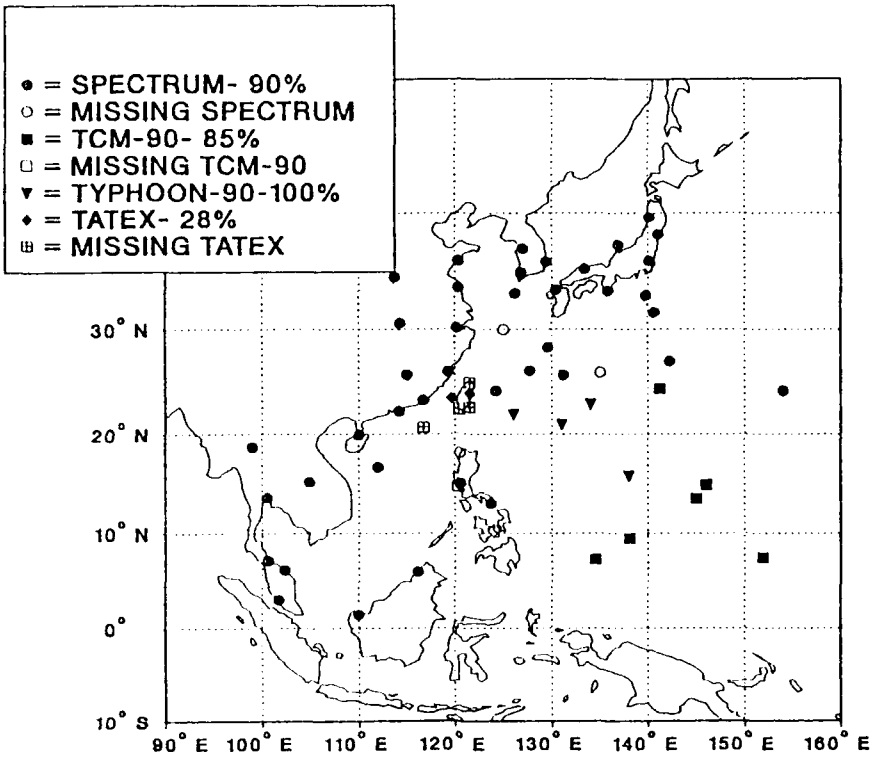


Figure 4.7 (continued)

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Mrs. Penny Jones assisted in the final editing of the report.

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APPENDIX A
TABLES OF FGGE-IIB FORMATS AND CODES.

This appendix contains the FGGE-IIB format definitions that are applicable to the TCM-90 raw observation data base. Definitions of the quality flags assigned to the real-time data are also included. More generalized definitions of the FGGE-IIB formats are available in Baker (1991).

TABLE A1. Upper-air format.

This format applies to radiosonde, PIBAL and dropwindsonde data. The observation type is specified by the data source index

a) Report Identification

Parameter	No. of chars.	Position number	Units	Remarks
Unique report identifier	1	1		Unique character = '*'
Data source index	2	2-3		See Table A7
Block station number	5	4-8		
Elevation	4	9-12	meters	
Latitude	5	13-17	deg. and hundreths	+=North -=South
Longitude	5	18-22	deg. and hundreths	0.00 to 359.99 (E-W)
Instrument type	2	23-24		Set to '99'
Year	2	25-26		90=1990
Month	2	27-28		01-12=Jan-Dec
Day	2	29-30		01-31
Hour	2	31-32		00-23 UTC
Mintues	2	33-34		00-59
No. of logical records (levels)	3	35-37		Variable number

TABLE A1 (continued)

b) Upper-air level data record

Parameter	No. of chars.	Position number	Units	Remark
Type of level	2	1-2		See Table A8
Pressure	5	3-7	10 mb	
Height	5	8-12	gpm	+=above sea level -=below sea level
Quality control: height[1]	2	13-14		See Table A9
Temperature	4	15-18	10^{-1} °C	
Quality control: temperature[1]	2	19-20		See Table A9
Dew-pt depression	4	21-24	10^{-1} °C	
Quality control: Dew-pt. depression[1]	2	25-26		See Table A9
Wind direction	3	27-29	deg.	
Wind speed	3	30-32	ms^{-1}	
Quality control: wind[1]	2	33-34		See Table A9
Record number	3	35-37		Level number within the report

[1]Two positions are reserved for the quality control flags applied to upper-air data. The first position is reserved for results of the horizontal checks performed as part of the NOGAPS MVOI. This position is not used for the TCM-90 data. The second position contains the results of the internal quality checks.

TABLE A2. AIRCRAFT REPORTS

This format applies to both the operational and DC-8 AIREP reports.

a) Report identification

Parameter	No. of chars.	Position number	Units	Remarks
Report identifier	1	1		Unique character='*'
Data source index	2	2-3		See Table A7
Aircraft Identification	6	4-9		First 6 characters of aircraft ID RECCO = DC-8 report
Type of wind	1	10		0=doppler,1=fix-to-fix,2=other
Number of wind reports	2	11-12		
Latitude	5	13-17	deg. and hundreths	+=North -=South
Longitude	5	18-22	deg. and hundreths	0.00 to 359.99 (E-W)
Optional record indicator	1	23		0=no,1=yes
Type of quality check	1	24		0=no QC check 1=horizontal QC 2=QC limits check
Year	2	25-26		90=1990
Month	2	27-28		01-12=Jan-Dec
Day	2	29-30		01-31
Hour	2	31-32		00-23 UTC
Minutes	2	33-34		00-59
Number of logical records	3	35-37		Variable number

TABLE A2 (continued)

b) First Aircraft data record

Parameter	No. of chars.	Position number	Units	Remark
Pressure	4	1-4	mb	At flight altitude
Quality control: Pressure	1	5		See Table A9
Height	5	6-10	meters	Pressure altitude
Quality control: height	1	11	10^{-1} °C	See Table A9
Temperature	4	12-15		At flight altitude
Quality control: temperature	1	16		See Table A9
Not used	4	17-20		
D-value	5	21-25	meters	
Not used	4	26-34		
Record number	3	35-37		Record number within report

c) Second aircraft data record

Parameter	No. of chars.	Position number	Units	Remark
Type of wind	2	1-2		0=doppler,1=fix-to-fix,2=other
Latitude of wind	4	3-6	deg. and tenths	
Longitude of wind	4	7-10	deg. and tenths	
Wind direction	3	11-13	degrees	
Wind speed	3	14-16	ms^{-1}	
Quality control: Wind	1	17		See Table A9
Not used	17	18-34		
Record number	3	35-37		Record number within report

TABLE A3. SURFACE REPORTS

This format applies to surface land, coastal marine, fixed ship, mobile ship and fixed buoy reports.

a) Report Identification

Parameter	No. of chars.	Position number	Units	Remark
Unique report identifier	1	1		Unique character = '*'
Data source index	2	2-3		See Table A7
Block station number	5	4-8		
Elevation	4	9-12	meters	
Latitude	5	13-17	deg. and hundreths	+=North -=South
Longitude	5	18-22	deg. and hundreths	0.00-359.99 (E-W)
Instrument type	2	23-24		Set to '99'
Year	2	25-26		90=1990
Month	2	27-28		01-12=Jan-Dec
Day	2	29-30		01-31
Hour	2	31-32		00-23 UTC
Minutes	2	33-34		00-59
Number of logical records	3	35-37		Variable number

TABLE A3 (continued)

b) First surface data record

Parameter	No. of chars.	Position number	Units	Remark
Total cloud amount	2	1-2	oktas	Code table 2700[1]
Wind direction	3	3-5	degrees	990=variable wind
Wind speed	3	6-8	ms^{-1}	
Quality control: wind	1	9		See Table A10
Horizontal visibility	2	10-11		Code table 4377
Present weather	2	12-13		Code table 4677
Past weather	2	14-15		Code table 4500
Pressure code indicator	1	16		See table A11
Sea-level or station pressure or geopotential height	5	17-21	10^{-1} mb or gpm	See pressure code indicator
Quality control: pressure/height	1	22		See Table A10
Air temperature	4	23-26	10^{-1} °C	
Quality control: temperature	1	27		See Table A10
Amount of C_L or C_M clouds	2	28-29	oktas	Code table 2700
Clouds of genera Sc,St,Cu,Cb(C_L)	2	30-31		Code table 0513
Height of cloud base	2	32-33		Code table 1600
Clouds of genera Ac,As,Ns(C_M)	2	34-35		Code table 0515
Clouds of genera Ci,Cs,Cc(C_H)	2	36-37		Code table 0509

[1] Table references apply to standard WMO code tables.

TABLE A3 (continued)

c) Second surface data record

Parameter	No. of chars.	Position number	Units	Remark
Dew-point depression	3	1-3	10^{-1} °C	
Quality control: dew-pt. depression	1	4		See Table A10
Not used	1	5		
Nature of pressure tendency	2	6-7		Code table 0200
Magnitude of pressure tendency	2	8-10	10^{-1} mb	
Quality control: pressure tendency	1	11		See Table A10
Not used	26	12-37		

TABLE A4. Drifting buoy format

This format applies to surface reports received from the TCM-90 drifting buoys.

a) Report Identification

Parameter	No. of chars.	Position number	Units	Remark
Unique report identifier	1	1		Unique character='*'
Data source index	2	2-3		See Table A7
Buoy number	5	4-8		See Table 2.2
Wind indicator	2	9-10		Always set to '0'
Indicator for surface data record	2	11-12		0=included in report 1=not included
Latitude	5	13-17	deg. and hundreths	+=North -=South
Longitude	5	18-22	deg. and hundreths	0.00 to 359.99 (E-W)
Number of subsurface records	2	23-24		
Year	2	25-26		90=1990
Month	2	27-28		01-12=Jan-Dec
Day	2	29-30		01-31
Hour	2	31-32		00-23 UTC
Minutes	2	33-34		00-59
Number of logical records	3	35-37		Variable number

TABLE A4 (continued)

b) Drifting buoy surface-data record

Parameter	No. of chars.	Position number	Units	Remark
Sea-level pressure	5	1-5	10^{-1} mb	
Quality control: pressure	1	6		See Table A10
Air temperature	4	7-10	10^{-1} °C	
Quality control: temperature	1	11		See Table A10
Sea-surface temperature	4	12-15	10^{-1} °C	
Quality control: sea-surface temperature	1	16		See Table A10
Wind direction	3	17-19	deg.	
Wind speed	3	20-22	ms^{-1}	
Quality control: wind	1	23		See Table A10
Not used	12	24-35		
Record number	3	35-37		Record no. within this report

TABLE A5. Satellite sounding format

a) Report identification

Parameter	No. of chars.	Position number	Units	Remark
Report indicator	1	1		Unique character='*'
Data source index	2	2-3		See Table A7
Not used	5	4-8		
Data processing indicator	2	9-10		See Table A12
Not used	2	11-12		
Latitude	5	13-17	deg. and hundreths	+=North -=South
Longitude	5	18-22	deg. and hundreths	0.00 to 359.99 (E-W)
Instrument type	2	23-24		See Table A13
Year	2	25-26		90=1990
Month	2	27-28		01-12=Jan-Dec
Day	2	29-30		01-31
Hour	2	31-32		00-23 UTC
Minutes	2	33-34		00-59
Number of logical records	3	35-37		Variable number

TABLE A5 (continued)

b) Miscellaneous satellite sounding data (always the second record within the satellite sounding observation)

Parameter	No.of chars.	Position number	Units	Remark
Type of level	2	1-2	Code figure=0	See Table A14
Not used	22	3-24		
Number of reported thickness layers	2	27-29		
Number of reported precipitable water layers	2	29-30		
Number of reported mean temperature layers	3	31-33		Not used
Quality control flag	1	34		See Table A15
Logical record number	3	35-37		Record number within this report

TABLE A5 (continued)

c) Optional record for satellite sounding thickness data

Parameter	No. of chars.	Position number	Units	Remark
Type of level	2	1-2	Code figure=1	See Table A14
Objective thickness quality indicator	2	3-4	percent	
Pressure at reference level	5	5-9	10^{-1} mb	base or standard pressure
Standard level pressure	5	10-14	10^{-1} mb	
Layer thickness	4	15-18	tens of gpm	
Objective thickness quality indicator	2	19-20	percent	
Standard level pressure	5	21-25	10^{-1} mb	
Standard level pressure	5	26-30	10^{-1} mb	
Layer thickness	4	31-34	tens of gpm	
Logical record number	3	35-37		within this report

TABLE A5 (continued)

d) Optional record for satellite sounding precipitable water data

Parameter	No. of chars.	Position number	Units	Remark
Type of level	2	1-2		See Table A14
Index of accuracy for precipitable water	2	3-4	percent	percent of derived value
Pressure at reference level	5	5-9	10^{-1} mb	base or standard pressure
Standard level pressure	5	10-14	10^{-1} mb	
Layer precipitable water	4	15-18	mm	
Index of accuracy for precipitable water	2	19-20	percent	
Standard level pressure	5	21-25	10^{-1} mb	
Standard level pressure	5	26-30	10^{-1} mb	
Layer precipitable water	4	31-34	mm	
logical record number	3	35-37		Within this report

TABLE A6. Satellite cloud-tracked winds

This format applies to both operational and reprocessed satellite cloud-tracked winds

a) Report identification

Parameter	No. of chars.	Position number	Units	Remark
Report indicator	1	1		Unique character = '*'
Data source index	2	2-3		See Table A7
Data processing method used	2	4-5		Code figure=05 for SSM/I
Not used	17	6-22		
Instrument type	2	23-24		See Table A13
Year	2	25-26		90=1990
Month	2	27-28		01-12=Jan-Dec
Day	2	29-30		01-31
Hour	2	31-32		00-23 UTC
Minutes	2	33-34		00-59
Number of logical records	3	35-37		Variable number

TABLE A6 (continued)

b) Record for wind and temperature

Parameter	No. of chars.	Position number	Units	Remark
Latitude	4	1-4	deg. and tenths	+=North -=South
Longitude	4	5-8	deg. and tenths	0.00 to 359.99 (E-W)
Not used	2	9-10		
Pressure	3	11-13	mb	at effective wind level
Subjective pressure confidence factor	1	14		See Table A16
Objective QC flag	1	15		See Table A15
Temperature	3	16-18	10^{-1} °C	
Wind direction	3	19-21	degrees	
Wind speed	3	22-24	ms^{-1}	
Not used	10	25-34		
Record number	3	35-37		Record number within this report

TABLE A7. Data source index

This code identifies the observation type. Only the codes applicable to the TCM-90 data set are included.

Code	Description
11	Radiosonde observation
12	Pilot balloon wind observation
15	Dropwindsonde observation
23	Aircraft observation
31	Surface observation from a manual or automatic land station
33	Surface observation from a fixed ship or buoy
34	Surface observation from a mobile ship
41	Satellite sounding observation
61	Satellite cloud-tracked wind observation
81	Surface observation from TCM-90 drifting buoy

TABLE A8. Type of level in an upper-air observation

Code	Description
01	Surface level but not a standard pressure or height level
02	Significant temperature or humidity
03	Tropopause, but not at a standard pressure level
04	Significant wind level not at a standard pressure level
05	Maximum wind level not at a standard pressure level
06	Significant temperature or humidity and wind level not at a standard pressure level
10	Standard pressure level
11	Surface level and standard pressure level
12	Significant temperature or humidity at a standard pressure level
13	Tropopause level and a standard pressure level
14	Significant wind level and a standard pressure level
15	Maximum wind level and a standard pressure level
16	Significant temperature or humidity and wind at a standard pressure level

TABLE A9. Quality-control codes for upper-air and aircraft observations

a) Vertical checks

Code	Description
0	Vertical check has not been made
1	Value found to be correct during vertical check
2	Value found to be suspect during vertical check
3	Value found to be in error during vertical check
4	Original value found to be in error during vertical check recomputed value inserted
5	Vertical check made and most likely vale entered
6	Original value missing - recomputed value inserted
7	Original value missing - value assigned
8	Value found to be in error during checks against certain limits
9	Original value missing - no vertical check made

b) Checks against limits

Code	Description
0	Checks against limits has not been made
1	Value found to be correct during limit check
2	Value found to be suspect during limit check
3	Value found to be in error during limit check
4	Original value found to be in error - recomputed value inserted
5	Checks against limits made - most likely value entered
6	Original value missing - recomputed value entered
9	Original value missing - no limit check made

TABLE A10. Quality-control codes for surface observations

Code	Description
0	Not checked
1	Original value found to be correct
2	Original value found to be suspect
3	Original value found to be in error
4	Original value found to be in error - substitution inserted (ship position only)
7	Value is consistent with past and present observations (ship position only)
8	Value is not consistent with past and present observations (ship position only)
9	Original value is missing - no checks made

TABLE A11. Pressure code indicator

Code	Description
0	Sea-level pressure
1	Station pressure
6	Geopotential of 850 mb
7	Geopotential of 700 mb
8	Geopotential of 500 mb
9	Unknown

TABLE A12. Indicator for data processing technique used in satellite soundings

Code	Description
0	Processing technique not specified
1	Clear path; automated statistical regression
2	Partly cloudy path; automated statistical regression
3	Cloudy path: automated statistical regression
4	Clear path: automated statistical regression - interactive quality control
5	Partly cloudy path: automated statistical regression - interactive quality control
6	Cloudy path: automated statistical regression - interactive quality control

TABLE A13. Instrument type for satellite observations

Code	Description
1	DMSP/SSMT F-8
2	DMSP/SSMT F-9
8	NOAA/TIROS/TOVS NOAA-10
9	NOAA/TIROS/TOVS NOAA-11
35	NOAA/TIROS/TOVS NOAA-10 (thickness reports)
36	NOAA/TIROS/TOVS NOAA-11 (thickness reports)
52	DMSP/SSMT F-8 (thickness reports)
53	DMSP/SSMT F-9 (thickness reports)
66	Unspecified geostationary satellite
99	Unknown

TABLE A14. Type of satellite sounding level

Code	Description
0	Miscellaneous SATEM information (required record)
1	Layer thickness between a reference pressure level and a standard isobaris surface
2	Layer precipitable water between a reference pressure level and a standard isobaric surface
3	Layer mean temperature between a reference pressure level and a standard isobaric surface

TABLE A15. Quality control code for satellite reports

Code	Description
0	Quality control check has not been made
1	The report is correct
2	The report is suspect
3	The report is in error

TABLE A16. Subjective confidence factor

Code	Description
0	Not specified
1	Low subjective confidence
2	Medium subjective confidence
3	High subjective confidence

APPENDIX B
TCM-90 tropical cyclone best-track data

This Appendix contains the 6-h best-track positions for each tropical cyclone that occurred during the field experiment phase of TCM-90.

TY WINONA

Storm number	Date	Position	Intensity(kts)
12	90080318	281N 1248E	15
12	90080400	286N 1254E	15
12	90080406	292N 1260E	15
12	90080412	298N 1266E	15
12	90080418	302N 1271E	15
12	90080500	306N 1275E	20
12	90080506	310N 1281E	20
12	90080512	310N 1286E	20
12	90080518	306N 1293E	25
12	90080600	299N 1300E	25
12	90080606	292N 1309E	25
12	90080612	285N 1318E	25
12	90080618	277N 1327E	25
12	90080700	270N 1340E	30
12	90080706	262N 1352E	35
12	90080712	255N 1360E	35
12	90080718	254N 1365E	40
12	90080800	257N 1370E	45
12	90080806	265N 1375E	50
12	90080812	276N 1375E	50
12	90080818	285N 1375E	55
12	90080900	296N 1375E	55
12	90080906	309N 1374E	60
12	90080912	323N 1374E	65
12	90080918	336N 1376E	65
12	90081000	349N 1384E	65
12	90081006	363N 1397E	55
12	90081012	379N 1411E	45
12	90081018	400N 1432E	45
12	90081100	419N 1455E	45
12	90081106	438N 1482E	40
12	90081112	456N 1516E	40
12	90081118	473N 1547E	40

TY YANCY

Storm number	Date	Position	Intensity(kts)
13	90080906	70N 1623E	15
13	90080912	70N 1613E	15
13	90080918	72N 1600E	15
13	90081000	76N 1590E	15
13	90081006	81N 1581E	15
13	90081012	85N 1574E	20
13	90081018	90N 1566E	20
13	90081100	94N 1558E	20
13	90081106	98N 1548E	25
13	90081112	104N 1537E	20
13	90081118	113N 1525E	20
13	90081200	122N 1514E	20
13	90081206	135N 1509E	20
13	90081212	146N 1504E	20
13	90081218	156N 1495E	20
13	90081300	165N 1487E	20
13	90081306	172N 1474E	25
13	90081312	177N 1460E	30
13	90081318	183N 1443E	30
13	90081400	186N 1425E	30
13	90081406	187N 1406E	35
13	90081412	189N 1387E	40
13	90081418	188N 1370E	45
13	90081500	186N 1355E	50
13	90081506	184N 1341E	55
13	90081512	186N 1329E	55
13	90081518	188N 1321E	55
13	90081600	191N 1312E	60
13	90081606	194N 1301E	60
13	90081612	196N 1290E	65
13	90081618	199N 1281E	70
13	90081700	203N 1274E	70
13	90081706	209N 1268E	70
13	90081712	214N 1261E	75
13	90081718	217N 1252E	85
13	90081800	218N 1247E	90
13	90081806	222N 1244E	90
13	90081812	229N 1241E	90
13	90081818	238N 1237E	90
13	90081900	245N 1228E	90
13	90081906	250N 1215E	85
13	90081912	251N 1208E	80
13	90081918	253N 1202E	70
13	90082000	254N 1197E	60
13	90082006	254N 1194E	55
13	90082012	254N 1192E	50
13	90082018	254N 1190E	45
13	90082100	254N 1187E	35
13	90082106	254N 1183E	30
13	90082112	254N 1180E	25
13	90082118	254N 1176E	20

13	90082200	254N 1173E	20
13	90082206	253N 1169E	15
13	90082212	253N 1165E	15

TY ZOLA

Storm number	Date	Position	Intensity(kts)
14	90081506	150N 1400E	25
14	90081512	146N 1411E	25
14	90081518	143N 1420E	20
14	90081600	146N 1428E	20
14	90081606	151N 1432E	20
14	90081612	155N 1434E	20
14	90081618	158N 1436E	25
14	90081700	164N 1439E	25
14	90081706	172N 1442E	30
14	90081712	180N 1445E	30
14	90081718	186N 1448E	30
14	90081800	191N 1451E	40
14	90081806	196N 1454E	55
14	90081812	200N 1457E	55
14	90081818	205N 1458E	55
14	90081900	212N 1452E	55
14	90081906	219N 1443E	55
14	90081912	224N 1433E	60
14	90081918	228N 1425E	60
14	90082000	232N 1417E	65
14	90082006	238N 1406E	70
14	90082012	247N 1393E	75
14	90082018	257N 1378E	80
14	90082100	269N 1362E	90
14	90082106	283N 1348E	100
14	90082112	296N 1336E	100
14	90082118	311N 1326E	95
14	90082200	329N 1323E	90
14	90082206	350N 1326E	85
14	90082212	377N 1336E	70
14	90082218	403N 1362E	55
14	90082300	415N 1404E	45
14	90082306	426N 1448E	45

TY ABE

Storm number	Date	Position	Intensity(kts)
15	90082212	100N 1520E	15
15	90082218	103N 1509E	15
15	90082300	105N 1499E	20
15	90082306	108N 1490E	20
15	90082312	110N 1480E	25
15	90082318	112N 1470E	25
15	90082400	115N 1459E	30
15	90082406	117N 1448E	30
15	90082412	119N 1438E	30
15	90082418	125N 1425E	30
15	90082500	129N 1415E	35
15	90082506	133N 1408E	35
15	90082512	135N 1404E	40
15	90082518	136N 1401E	45
15	90082600	137N 1402E	45
15	90082606	141N 1406E	50
15	90082612	146N 1409E	50
15	90082618	162N 1410E	55
15	90082700	176N 1408E	55
15	90082706	192N 1397E	55
15	90082712	202N 1383E	60
15	90082718	211N 1367E	65
15	90082800	217N 1350E	70
15	90082806	223N 1335E	70
15	90082812	228N 1322E	75
15	90082818	232N 1308E	75
15	90082900	235N 1292E	80
15	90082906	239N 1277E	80
15	90082912	242N 1265E	85
15	90082918	246N 1256E	85
15	90083000	252N 1248E	90
15	90083006	259N 1239E	90
15	90083012	265N 1230E	90
15	90083018	274N 1223E	90
15	90083100	283N 1218E	85
15	90083106	292N 1212E	80
15	90083112	300N 1208E	75
15	90083118	308N 1205E	65
15	90090100	317N 1205E	50
15	90090106	329N 1205E	45
15	90090112	345N 1213E	40
15	90090118	360N 1229E	35
15	90090200	374N 1253E	35
15	90090206	385N 1284E	25

TY BECKY

Storm number	Date	Position	Intensity(kts)
16	90082006	134N 1407E	10
16	90082012	139N 1392E	10
16	90082018	148N 1380E	10
16	90082100	155N 1371E	10
16	90082106	160N 1360E	10
16	90082112	160N 1352E	10
16	90082118	160N 1345E	10
16	90082200	160N 1337E	10
16	90082206	160N 1330E	15
16	90082212	161N 1323E	15
16	90082218	164N 1317E	20
16	90082300	166N 1311E	20
16	90082306	169N 1304E	20
16	90082312	171N 1299E	25
16	90082318	174N 1296E	25
16	90082400	176N 1294E	25
16	90082406	177N 1292E	30
16	90082412	179N 1290E	30
16	90082418	182N 1288E	30
16	90082500	187N 1283E	35
16	90082506	192N 1273E	35
16	90082512	197N 1258E	45
16	90082518	195N 1242E	50
16	90082600	191N 1231E	55
16	90082606	186N 1220E	60
16	90082612	181N 1209E	65
16	90082618	179N 1198E	65
16	90082700	178N 1188E	65
16	90082706	177N 1177E	65
16	90082712	177N 1164E	70
16	90082718	177N 1151E	70
16	90082800	177N 1138E	70
16	90082806	177N 1125E	70
16	90082812	177N 1113E	70
16	90082818	177N 1103E	70
16	90082900	178N 1090E	70
16	90082906	177N 1076E	70
16	90082912	177N 1062E	65
16	90082918	177N 1046E	60
16	90083000	178N 1029E	50
16	90083006	182N 1011E	40

TY DOT

Storm number	Date	Position	Intensity(kts)
17	90090206	162N 1490E	15
17	90090212	158N 1466E	20
17	90090218	154N 1455E	20
17	90090300	148N 1444E	20
17	90090306	143N 1430E	25
17	90090312	140N 1417E	25
17	90090318	142N 1405E	30
17	90090400	146N 1395E	30
17	90090406	145N 1387E	35
17	90090412	146N 1378E	35
17	90090418	153N 1367E	40
17	90090500	162N 1356E	45
17	90090506	172N 1341E	50
17	90090512	179N 1326E	55
17	90090518	184N 1312E	60
17	90090600	190N 1299E	65
17	90090606	197N 1284E	65
17	90090612	204N 1269E	70
17	90090618	210N 1254E	75
17	90090700	217N 1243E	75
17	90090706	222N 1232E	75
17	90090712	229N 1221E	70
17	90090718	236N 1208E	65
17	90090800	241N 1192E	70
17	90090806	245N 1180E	70
17	90090812	249N 1170E	60
17	90090818	252N 1163E	50
17	90090900	255N 1157E	45
17	90090906	257N 1152E	25

TY CECIL

Storm number	Date	Position	Intensity(kts)
18	90090206	201N 1229E	15
18	90090212	210N 1228E	15
18	90090218	219N 1228E	20
18	90090300	228N 1228E	25
18	90090306	237N 1228E	25
18	90090312	246N 1226E	25
18	90090318	254N 1220E	30
18	90090400	259N 1212E	35
18	90090406	266N 1206E	40
18	90090412	272N 1202E	45
18	90090418	276N 1205E	35
18	90090500	283N 1209E	20

TY ED

Storm number	Date	Position	Intensity(kts)
19	90090700	132N 1572E	15
19	90090706	133N 1561E	15
19	90090712	137N 1550E	15
19	90090718	141N 1539E	15
19	90090800	147N 1530E	20
19	90090806	152N 1520E	20
19	90090812	158N 1510E	20
19	90090818	166N 1502E	20
19	90090900	175N 1495E	25
19	90090906	182N 1491E	25
19	90090912	188N 1486E	25
19	90090918	192N 1479E	25
19	90091000	194N 1471E	25
19	90091006	195N 1463E	30
19	90091012	196N 1451E	30
19	90091018	197N 1438E	30
19	90091100	197N 1423E	30
19	90091106	197N 1408E	35
19	90091112	198N 1393E	35
19	90091118	199N 1381E	35
19	90091200	199N 1368E	35
19	90091206	199N 1355E	40
19	90091212	199N 1342E	45
19	90091218	199N 1329E	45
19	90091300	200N 1314E	45
19	90091306	200N 1298E	45
19	90091312	200N 1282E	45
19	90091318	200N 1266E	55
19	90091400	198N 1250E	65
19	90091406	194N 1235E	65
19	90091412	190N 1219E	70
19	90091418	186N 1205E	70
19	90091500	182N 1193E	70
19	90091506	178N 1181E	70
19	90091512	174N 1169E	70
19	90091518	171N 1159E	70
19	90091600	167N 1149E	75
19	90091606	164N 1142E	75
19	90091612	161N 1135E	80
19	90091618	160N 1130E	90
19	90091700	159N 1125E	90
19	90091706	159N 1119E	85
19	90091712	159N 1112E	80
19	90091718	159N 1105E	80
19	90091800	162N 1097E	75
19	90091806	164N 1089E	75
19	90091812	167N 1082E	70
19	90091818	169N 1077E	60
19	90091900	171N 1072E	55
19	90091906	175N 1065E	50

19	90091912	180N 1058E	45
19	90091918	187N 1054E	35
19	90092000	194N 1050E	30
19	90092006	201N 1047E	25

STY FLO

Storm number	Date	Position	Intensity(kts)
20	90090800	55N 1705E	15
20	90090806	61N 1685E	15
20	90090812	68N 1666E	15
20	90090818	75N 1648E	15
20	90090900	80N 1630E	15
20	90090906	82N 1620E	15
20	90090912	84N 1612E	15
20	90090918	87N 1602E	15
20	90091000	90N 1591E	15
20	90091006	92N 1580E	15
20	90091012	93N 1568E	15
20	90091018	93N 1556E	15
20	90091100	93N 1544E	15
20	90091106	94N 1532E	15
20	90091112	96N 1518E	15
20	90091118	99N 1504E	20
20	90091200	105N 1491E	20
20	90091206	114N 1479E	20
20	90091212	125N 1471E	25
20	90091218	136N 1461E	25
20	90091300	145N 1447E	25
20	90091306	151N 1433E	30
20	90091312	156N 1422E	35
20	90091318	163N 1411E	40
20	90091400	171N 1400E	45
20	90091406	180N 1389E	50
20	90091412	188N 1377E	55
20	90091418	195N 1365E	60
20	90091500	202N 1354E	65
20	90091506	209N 1344E	70
20	90091512	216N 1334E	75
20	90091518	222N 1324E	85
20	90091600	228N 1315E	100
20	90091606	233N 1307E	115
20	90091612	237N 1300E	130
20	90091618	242N 1295E	135
20	90091700	248N 1291E	135
20	90091706	256N 1289E	145
20	90091712	262N 1290E	145
20	90091718	268N 1292E	135
20	90091800	275N 1296E	125
20	90091806	284N 1302E	115
20	90091812	294N 1310E	110
20	90091818	304N 1318E	105
20	90091900	313N 1327E	95

20	90091906	325N	1341E	90
20	90091912	340N	1358E	85
20	90091918	361N	1374E	65
20	90092000	386N	1400E	55
20	90092006	403N	1440E	50
20	90092012	417N	1484E	45
20	90092018	429N	1529E	45
20	90092100	440N	1578E	50
20	90092106	453N	1631E	50
20	90092112	464N	1678E	50
20	90092118	473N	1728E	50
20	90092200	480N	1780E	50

APPENDIX C

Job control language used to write the two TCM-90 raw observation data tapes

TAPE 1

```
FILE: GETAPE1  TCM      A1

//GETAPE1 JOB (0691,9999),'HARR',CLASS=G
//*MAIN LINES=99
//STEP01   EXEC PGM=IEBGENER
//SYSPRINT DD SYSOUT=A
//SYSIN    DD DUMMY
//SYSUT1 DD DSN=MSS.F0691.TCM.T11,DISP=SHR                    RADIOSONDES
//SYSUT2 DD UNIT=3400-5,VOL=SER=TCM1,DISP=(NEW,PASS),
//     DCB=(LRECL=40,BLKSIZE=6400,RECFM=FB,OPTCD=Q,DEN=4)
//     LABEL=(1,NL,,OUT)
/*
//STEP02   EXEC PGM=IEBGENER
//SYSPRINT DD SYSOUT=A
//SYSIN    DD DUMMY                                           PILOT BALLOONS
//SYSUT1 DD DSN=MSS.F0691.TCM.T12,DISP=SHR
//SYSUT2 DD UNIT=3400-5,VOL=SER=TCM1,DISP=(NEW,PASS),
//     DCB=(LRECL=40,BLKSIZE=6400,RECFM=FB,OPTCD=Q,DEN=4),
//     LABEL=(2,NL,,OUT)
/*
//STEP03   EXEC PGM=IEBGENER
//SYSPRINT DD SYSOUT=A
//SYSIN    DD DUMMY
//SYSUT1 DD DSN=MSS.F0691.TCM.T15,DISP=SHR                    DROPWINDSONDES
//SYSUT2 DD UNIT=3400-5,VOL=SER=TCM1,DISP=(NEW,PASS),
//     DCB=(LRECL=40,BLKSIZE=6400,RECFM=FB,OPTCD=Q,DEN=4),
//     LABEL=(3,NL,,OUT)
/*
//STEP04   EXEC PGM=IEBGENER
//SYSPRINT DD SYSOUT=A
//SYSIN    DD DUMMY
//SYSUT1 DD DSN=MSS.F0691.TCM.T23,DISP=SHR                  OPERATIONAL AIREPS
//SYSUT2 DD UNIT=3400-5,VOL=SER=TCM1,DISP=(NEW,PASS),
//     DCB=(LRECL=40,BLKSIZE=6400,RECFM=FB,OPTCD=Q,DEN=4),
//     LABEL=(4,NL,,OUT)
/*
//STEP05   EXEC PGM=IEBGENER
//SYSPRINT DD SYSOUT=A                                      DC-8 AIREPS
//SYSIN    DD DUMMY                                         (5 MINUTE RESOLUTION)
//SYSUT1 DD DSN=MSS.F0691.TCM.T23DC8,DISP=SHR
//SYSUT2 DD UNIT=3400-5,VOL=SER=TCM1,DISP=(NEW,PASS),
//     DCB=(LRECL=40,BLKSIZE=6400,RECFM=FB,OPTCD=Q,DEN=4),
//     LABEL=(5,NL,,OUT)
/*
//STEP06   EXEC PGM=IEBGENER
//SYSPRINT DD SYSOUT=A
//SYSIN    DD DUMMY
//SYSUT1 DD DSN=MSS.F0691.TCM.T31,DISP=SHR                SURFACE LAND STATION
//SYSUT2 DD UNIT=3400-5,VOL=SER=TCM1,DISP=(NEW,PASS),
//     DCB=(LRECL=40,BLKSIZE=6400,RECFM=FB,OPTCD=Q,DEN=4),
//     LABEL=(6,NL,,OUT)
/*
//STEP07   EXEC PGM=IEBGENER
//SYSPRINT DD SYSOUT=A                                      FIXED SHIP OR BUOY
//SYSIN    DD DUMMY                                         SURFACE OBSERVATION
//SYSUT1 DD DSN=MSS.F0691.TCM.T33,DISP=SHR
//SYSUT2 DD UNIT=3400-5,VOL=SER=TCM1,DISP=(NEW,PASS),
//     DCB=(LRECL=40,BLKSIZE=6400,RECFM=FB,OPTCD=Q,DEN=4),
//     LABEL=(7,NL,,OUT)
//
```

TAPE 2

FILE: GETAPE2 TCM A1

```
//GETAPE2  JOB (0691,9999),'HARR',CLASS=G
//*MAIN LINES=99
//STEP01   EXEC PGM=IEBGENER
//SYSPRINT DD SYSOUT=A
//SYSIN    DD DUMMY                                          MOBILE SHIP
//SYSUT1 DD DSN=MSS.F0691.TCM.T34,DISP=SHR                   SURFACE OBSERVATION
//SYSUT2 DD UNIT=3400-5,VOL=SER=TCM2,DISP=(NEW,PASS),
//     DCB=(LRECL=40,BLKSIZE=6400,RECFM=FB,OPTCD=Q,DEN=4),
//     LABEL=(1,NL,,OUT)
/*
//STEP02   EXEC PGM=IEBGENER
//SYSPRINT DD SYSOUT=A
//SYSIN    DD DUMMY                                          SATELLITE SOUNDING
//SYSUT1 DD DSN=MSS.F0691.TCM.T41,DISP=SHR
//SYSUT2 DD UNIT=3400-5,VOL=SER=TCM2,DISP=(NEW,PASS),
//     DCB=(LRECL=40,BLKSIZE=6400,RECFM=FB,OPTCD=Q,DEN=4),
//     LABEL=(2,NL,,OUT)
/*
//STEP03   EXEC PGM=IEBGENER
//SYSPRINT DD SYSOUT=A
//SYSIN    DD DUMMY                                  SATELLITE CLOUD-TRACKED WINDS
//SYSUT1 DD DSN=MSS.F0691.TCM.T61,DISP=SHR
//SYSUT2 DD UNIT=3400-5,VOL=SER=TCM2,DISP=(NEW,PASS),
//     DCB=(LRECL=40,BLKSIZE=6400,RECFM=FB,OPTCD=Q,DEN=4),
//     LABEL=(3,NL,,OUT)
/*
//STEP04   EXEC PGM=IEBGENER                                 TCM-90 DRIFTING BUOYS
//SYSPRINT DD SYSOUT=A                                       SURFACE REPORTS
//SYSIN    DD DUMMY
//SYSUT1 DD DSN=MSS.F0691.TCM.T81,DISP=SHR
//SYSUT2 DD UNIT=3400-5,VOL=SER=TCM2,DISP=(NEW,PASS),
//     DCB=(LRECL=40,BLKSIZE=6400,RECFM=FB,OPTCD=Q,DEN=4),
//     LABEL=(4,NL,,OUT)
//
```